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At a recent meeting of the London Physical Society, Dr. J. A. Fleming made use of an ingenious model to facilitate the interpretation of certain fundamental equations considered in the study of the propagation of alternating current along a telephone cable. If instructors in mathematics, whenever and wherever possible, would go to more trouble to interpret by means of graphics, or by a mechanical model, if necessary, the equations which they deduce, many an otherwise good student could come up to his calculus with the ability to think in literal factors, and not depend entirely upon his faculty for remembering and applying formulæ. From the first lesson, the mathematics of engineering should be made a living subject, and the student impressed with the importance of solid ground work for success in his profession. He should be made aware that each division of the subject has an intimate and inevitable relation with the others, and that each should be taken up consecutively and cumulatively, and that no one part, however unattractive, should be neglected.

THE ELECTRIC CAR CONTROLLER.

The popular idea of the controller of the electric car seems to be that it is an iron box containing a good deal of delicate mechanism which, in some incomprehensible manner, performs certain complicated functions. Many, no doubt, think that the controller cover conceals electromagnets, gear wheels, rods, wires and other devices, all in imminent danger of flying to pieces when anything goes wrong. This is not true, for although the action of the controller may seem complicated to one who has not made a study of such devices, the mechanism of the controller is exceedingly simple. When anything happens to the controller, it is the controller itself which suffers. It is true that sometimes the motorman's clothing may be damaged under such circumstances by hot metal, but the passengers themselves, if they are where they belong, are in no danger. Every one appreciates the startling character of a brilliant electric arc suddenly appearing when and where least expected, but the electric arc is not dangerous to those who remain at a respectful distance.

The Controller an Electric Faucet.

The electric controller used on a street car may be compared with a water faucet, though, of course, the analogy must not be pushed too hard. Its function is to regulate the supply of current both in amount and in the way it flows through the car motors. It allows the current to flow first through a single path, and, by steps, reduces the opposition to this flow, thus allowing the current to increase. It then supplies two paths, as though two faucets were opened, and again by steps allows the current to increase through each of these paths.

Methods of Connecting Motors.

For convenience in manipulation, all electrical connections, except such as are permanent, are made by the controller. Exception is made in the cases of the fuse and circuit-breaker, which are safety devices, and, for this reason, are separated from the controller and are isolated. The function of these two is to open the conducting circuit when the current flowing through the car is too great. Other than this they have no effect on the motors. An electric motor consists of two parts, each of which contains a winding of copper wire. The rotating part is called the armature, and the fixed part, the field. From each end of these two windings wires are carried to each of the car's controllers. Since there are two motors, there will thus be eight wires carried in a cable under the car floor and up through the platform floor to the controller. An additional connection may be made to the field winding, for the purpose of giving a greater range of speed, but this is not essential to the working of the car. Besides the car motors, there is under the car the so-called rheostat, a device for preventing the flow of excessive currents. This device is usually divided into two or three sections. When

all of it is connected in the circuit, the greatest resistance is offered to the flow of current. As it is cut out by the controller, the resistance it offers decreases until it is finally all removed. Assuming two sections of the rheostat, there will then be three wires carried from this piece of apparatus to each controller. There are two other wires, one by which connection is made to the trolley, and the other making connection through the car truck to the rails. In all, this makes thirteen wires led into each controller.

Function of the Controller.

The function of the controller is merely to establish suitable electrical connections between these thirteen wires. When the controller handle is first turned, everything is connected, as we say, in series—that is, the current coming to the car from the trolley wire passes through the rheostat to the field winding of one motor, then through its armature, next to the field winding of the second motor, finally passing through its armature to the track. The next two or three moves of the controller handle merely cut out the rheostat in steps, just as though a faucet handle were given two or three turns, opening it wider to allow more water to flow. The next movement of the controller handle causes the current entering the car to pass first through the rheostat. It then has two paths by which it may reach the track—one through each motor. Further movements of the controller handle cut out the rheostat as before, leaving the two motors connected directly between the trolley and the rail by means of the wires running through the controller.

Construction of the Controller.

The movable part of the controller is an iron spindle, upon which is arranged a series of metallic discs insulated from the spindle. These discs are connected together in pairs, and they are partially cut away at the periphery, so that they represent a series of cams. On the back of the controller are a number of brass blocks supported on springs, which press each of them in contact with its corresponding disc whenever the projecting portion of the latter comes opposite to the contact block. To each of these blocks one of the car wires is connected. In this way the electrical connections just explained are made successively as the handle of the controller is turned. When the handle is at the off position, none of the contact blocks is touching the discs. There is, in addition, the reversing lever, which is placed in the controller box, but this is only operated when the regulating handle is thrown off, and it merely makes the necessary change in the method of connecting the motors so that the car may be run in either direction.

When a Controller "Blows Out."

What happens when a controller breaks down, or, as the motorman would say, "blows out," is either that too large a current has been allowed to pass through some of the wires in the controller—a rare accident which should be prevented by the fuse; or, in throwing the controller to the off position, which should break the current, the latter has instead jumped from one contact block to another, or to the frame of the controller. This produces what is called a short-circuit—that is to say, a path offering little resistance to the flow of current from the trolley wire to the track. This arc may cause more or less damage to the wires and metal of the controller before it goes out, but the damage is usually slight and is confined to a small spot. It is to be expected that the average passenger on an electric car is startled when something goes wrong, with a bright flash and a loud report, but he is learning rapidly that this does not signify danger, and that he is safest if he sits still. On the other hand, electrical apparatus is being improved rapidly, so that such accidents are becoming rare. In some of the latest types of controlling systems the main motor current does not pass through the controllers—in fact, it at no time in its passage is above the car floor.

RUBBER CULTURE.

A short time ago we made note of a report from a United States consul in Mexico, relating to rubber culture in that country, which took a discouraging view of the matter. This consul could see no success in prospect for the many rubber plantations which have been started there, and on which large sums of money have been expended. He thought, however, that there was some hope that new rubber fields might be discovered, and that in this way the increasing demand for this product would be met.

Good Outlook in Brazil.

The following week another report was noted, this time from the United States consul at Para, Brazil. This report took the opposite view, and gave some details of several rubber plantations in that country which are already yielding latex, and which promise to become important, not only as a source of rubber, but as demonstrating the success with which these trees may be planted and cultivated.

A Criticism.

As is well known, rubber is the most important insulator we have yet discovered for high-tension conductors and for inside wiring. The demand for this material is increasing enormously, and it is therefore important to know which of the two reports alluded to is to be trusted. The subject is considered in a sharp editorial appearing in the current issue of the *India Rubber World,* which criticises the report of our consul in Mexico, takes him to task for not ascertaining the correct facts, and which states that there are now plantations in Mexico well advanced, with every prospect that they will be successful as sources of rubber.

Rubber-Growing in Ceylon.

This issue of our contemporary also contains a letter from its editor, who is at this time making a trip for the purpose of inspecting the rubber-producing countries. In this details are given of a visit to several plantations in Ceylon, where there are large trees already giving good yields. There seems to be no difficulty in raising the trees from seeds, and the methods of tapping the tree and of curing the latex are receiving study. The letter takes a very encouraging view of the situation, as not only have the trees already planted flourished, but there are large sections of country which have not been planted, but which are suitable for rubber culture. It is exceedingly gratifying to learn through such a reliable authority that there is little danger of a rubber famine in the near future.

ELECTRIC CRANES.

The advantages of using electrical means for carrying out mechanical operations have been demonstrated again in a recent paper before the American Society of Mechanical Engineers. At the Chicago meeting, Mr. V. L. Raven described the crane equipment on the Northeastern Railway dock, at Middlesbrough, England. When the dock was first constructed, it was equipped with steam cranes. Twelve years later an extension was made, and hydraulic cranes supplied to the new work. When the present extension was proposed, it was decided to abandon the steam cranes and to supply their places with electric cranes. There was an electric lighting station at the dock, and this was enlarged so as to make one large electric plant to supply the necessary power as well as light. Mr. Raven's paper describes the equipment of the station and dock. There are twenty-four electric cranes, twenty-six electric capstans, and twelve hydraulic cranes. The capacity of the cranes varies from three tons to ten tons. As the new apparatus is in operation side by side with the old, an excellent opportunity is offered for a test of the comparative merits of the electric and hydraulic methods. Advantage was taken of this, and careful tests made, the results of which are much in favor of the electric cranes.

The Hydraulic Cranes.

The hydraulic cranes are of modern design. They are operated by three vertical cylinders for lifting. Water is admitted into one cylinder for light power, in two for moderate power, and in all three for full load. Slewing is done by gearing driven by small vertical four-cylinder capstan engines. The working pressure at the crane during the tests was 700 pounds. The tests consisted in lifting loads of rails a height of twenty feet, slewing through half a circle, and then lowering them to empty cars. Six cranes were tested, handling 600 tons as constant loads and 600 tons as variable loads.

Results of Tests.

The electric cranes were put through the same operation. These cranes are equipped with three motors—one for lifting, one for slewing and one for shifting the crane along the track. The results of the test show that seven hours were required by the hydraulic cranes to do the work performed by the electric cranes in five hours and fifteen minutes, a loss of one hour and forty-five minutes. The cost of working at the power station for the hydraulic cranes was $3.35. For the electrics the cost was $3.03, a saving of about ten per cent. Allowing for interest, depreciation, repairs, wages, etc., the cost for handling this material by means of the hydraulic cranes was $79.29. The corresponding figure for the electric cranes was $59.94. This shows a saving in favor of the electric cranes of $19.35, or about twenty-five per cent.

However, this does not tell the whole story, for the electric cranes are easier to handle, and the operator does not need to put forth much effort, as is the case with the hydraulic cranes. Further, when it is necessary to shift the hydraulic cranes to suit working into the different ships' holds, six men have to be called an hour earlier in the morning to set the four cranes required by each vessel. To make a corresponding shifting of the electric cranes, it is not necessary to call the men any earlier, for two men in summer and four men in winter can disconnect and connect up four cranes in fifteen minutes. Again, in winter, on cold nights four men have to be employed six hours each for the purpose of keeping up fires to prevent the water freezing in the cylinders of the hydraulic cranes. The electric cranes are also fitted with a number of safety devices, which prevent overloading and otherwise guard against negligence or unforeseen contingencies, and an electric cable is more flexible and easier to lay down and shift about than pipes subjected to high pressures.

Electricity as Means to an End.

Electrical methods of carrying out mechanical operations are deservedly becoming more and more popular. This is not because there is any particular virtue in electricity itself, nor because the electric motor has a superior method of turning around. Electricity merely furnishes a means to an end. For transmitting power from one point to another, it is the best means yet discovered.

SOME CRITICAL OBSERVATIONS IN A CENTRAL STATION.

BY HOWARD S. KNOWLTON.

The study of modern power plant practice brings to light many differences in design and operation as one goes from place to place. It is always worth while to spend time in new installations, because practically every electric light or power station is an attempt to solve its own peculiar problems—questions which are seldom precisely similar to those of any other plant. The fundamental features of the central station business may be the same in Cape Town as in Los Angeles, but the details of generating, distributing and selling current vary widely between even adjoining towns and cities.

It is a mistake to claim that an old plant can not be as instructive in payment for an examination as a new one. At least, it teaches us what not to do, which is quite as important as knowing what is best to do. Central station work will have to be even more standardized than it is at present, before the old plants that have borne the brunt of from ten to twenty years' business, lose their power to guide both designer and operator toward the paths of greater economy. The writer believes that it will be worth while to criticise some of the features of a large central station now serving a city of over 100,000 people, in the interest of that increased efficiency, which is to-day being so earnestly sought by industrial managers.

The plant in question does a large lighting and power business, but handles no railway load. It has no serious competition to fight, and by the adoption of up-to-date methods in its commercial department, has enormously increased its output and revenue within the last two or three years. Conspicuous among these methods, are aggressive advertising in the daily papers of the city; lectures to the public in the company's own demonstration hall; the mailing of timely bulletins to customers and prospective buyers of current at judicious intervals, treating of new apparatus, etc.; and the throwing open of a portion of its offices for the public use and convenience as a waiting

room in the busy downtown section of the city. Even the troublesome meter problem has been met in an open and aboveboard manner by the installation of an ampere-hour meter in the waiting room, which instrument is connected with a load of switches and lamps and its function explained for the benefit of all customers who desire to learn how current is measured and recorded.

Even a casual visitor to a power plant indicates that the demand for current stimulated by the aggressive tactics of the business department has far outrun the design of the station. It is evident that little opportunity has been accorded the management to consider redesigning the entire system. The keynote of the plant's operation is the remarkable contrast between the equipment and its arrangement. The lack of harmony between the modern apparatus used and its inconvenient and inefficient layout is as striking as would be the equipment of a Noah's ark with steam turbines in competition with an Atlantic liner for the mail-carrying contract.

Approaching the plant, six stacks rise above the boiler room roof, five being steel and one brick. Three of the steel stacks are nearly as high as the brick chimney, and the other two about half as high. The architectural incongruity might be passed over, but it is difficult to see why this hodge-podge of construction is not superseded by a second brick or steel stack of sufficient capacity and economy to carry at least half the flue gases of the plant into the air. Certainly two stacks should be capable of handling the requirements of a 5,000-kilowatt station—this being the approximate rated capacity of the plant at present. The coal handling arrangements are likewise objectionable. A spur track parallels the outer boiler room wall, but the coal has to be shoveled by hand from the cars to the bins, and when it finally gets into the building it slides down upon the boiler room floor in chunks larger than a man's head, obstructing the passageway before the furnace doors so that the firemen have to be nearly as agile as their brother upon an express locomotive in stoking the furnaces. Cleanliness was foreign to any part of the boiler room.

The latest addition to the plant deserves only favorable comment, save for its being housed in a flimsy wooden addition to the main station, which is a bad fire risk. This unit consists of a direct-connected Bullock three-phase, 1,500-kilowatt, 2,400-volt, revolving field alternator, driven by a 2,500-horse-power, horizontal Filer & Stowell engine, and it bears the distinction of being the only direct-connected unit in the station, although a duplicate set is about to be installed. As the above unit has been operating over a year, there would seem to be no good reason for the failure to build proper fireproof walls around at least fifty or sixty thousand dollars' worth of machinery.

Perhaps the most striking example of inefficient practice in the plant is found in the engine and dynamo room. Four horizontal cross-compound Corliss type engines drive the following generators by belting either directly to the engine flywheels or to pulleys on a long countershaft running nearly the length of the room: one 200-kilowatt, 275-volt Bullock direct-current machine; one single-phase, 500 kilowatt, General Electric 2,400-volt alternator; two 100-kilowatt, General Electric, 250-volt direct-current generators; two 200-kilowatt, General Electric 250-volt dynamos; one 400-kilowatt, General Electric, 250-volt machine; one 700-kilowatt, Bullock, 275-volt generator, and two 300-kilowatt, 2,200-volt Bullock alternators. One engine carries three belts upon its single flywheel—one above the other—and the whole engine room is so occupied with belts that it would be a hopeless task to operate a traveling crane in its precincts, if such a device were installed. The machinery is so closely placed that it is difficult to see through the entire length of the engine room from many points within it, and in one case the passageway between the engine flywheel and the wall is cut down to scarcely eighteen inches. With the wheel circumference making sixty miles an hour it is not a place to pass through carelessly.

The evils of belt connection, particularly in large cities, are so well known, that a reference to this plant would perhaps not be warranted if it were not for the fact that all the generators but one appear to be of thoroughly modern design, and compare favorably in appearance and technical features with the best machines now on the market. These generators are all set upon the engine room floor level and foundations, and in this room also are placed the various pumps, condensers and piping, which make up the steam end of the plant.

All the switchboard apparatus is placed upon a floor about twenty feet above the engine room, and there is great difficulty in communicating easily with the switchboards from the floor below. In fact, the switchboards are to all intents and purposes in a separate room from the engines and generators, with no evidence of ready connection between the mechanical and electrical operating shifts, except that afforded by a winding, iron stairway, which leads from one room to the other. To cap the climax of complication, seven fifty-kilowatt, 5,000-volt Brush arc machines are set upon the floor of the switchboard room and driven by long belts from the shafting in the engine room, while an old No. 10 Brush arc machine is belt-driven from a pulley on a General Electric, fifty-horse-power, 500-volt motor alongside a fifty-kilowatt Brush arc dynamo belted to a seventy-five-horse-power, 220-volt, General Electric shunt motor. In the switchboard room the cables run in part on the floor, without visible means of insulating support; there are five separate switchboards, one of which is temporarily built up of entirely wooden panels, carrying 2,400-volt switches bolted directly upon the wood without the slightest insulation for carrying over 2,000 kilowatts in electrical energy. The fire risk of this arrangement deserves the severest criticism, and the oil-soaked wooden floor, absence of fire protective apparatus, and discoloration of some of the switch blades from overheating, do not indicate the absence of danger in this part of the plant, to put it mildly.

On the same floor with the switchboard room is a neatly equipped machine shop. The various lathes, grindstones, hammers, drills and the shaper are driven from line shafting run by a four-horse-power, Crocker-Wheeler shunt motor, but the blacksmith shop forge is operated by an extra man instead of by a power-driven blower. The company apparently has perceived the waste entailed here, as it is installing a locomotive air compressor for supplying a draught to the forge; but there is no doubt that far greater efficiency would be obtained by belting a small blower directly to the line shaft of the shop, which runs within a few feet of the forge. The ventilation of the shop is faulty as far as the forge smoke is concerned, and there is every reason for installing a longer flue with a better draught at the forge, which should eliminate the discomfort and delays caused by the smoke.

The handicap that surrounds the operating force is well illustrated in the fact that four employés in the plant were asked the cylinder sizes of the 2,500-horse-power engine, and none were able to give the information. The chief engineer himself was apparently too busy to state whether or not he possessed this data, when asked if he could supply it. On the bulletin board was a statement from the officials of the company offering cash prizes for the increase of watts output above 140 per pound of coal by the efforts of employés. Although the notice was over six months' old, one of the engineers admitted that he had never even read it. Under such conditions it is certainly difficult to expect much increase in the economy of operation.

The writer presents these criticisms from actual practice in one particular plant with no desire to overlook the many admirable features of the company's work, but with the object of pointing out conditions which must be remedied wherever they exist, if the broadest success is to be secured and retained.

Winding a Direct-Current Generator Armature.

Mr. Arthur Wagner, in the July issue of the *Electric Club Journal,* describes the connection and construction of the armature winding of a direct-current generator of standard design. The armature has coils formed from copper strap, and the winding is of the multi-phase circuit type, in both of these respects typical of the larger sizes of direct-current armatures.

The armature has eighty slots, in which are placed eighty complete coils, two sides of two coils per slot, or what is commonly called two coils per slot. Each complete coil consists of three single coils of one turn each. The complete coil is made by forming the bare strap on a cast-iron former, the single straps are separately insulated from each other, after which the complete coil is insulated. The rear end is of the "involute" shape, and the front end is of the "diamond" shape. The shape of the end connections of the coil is determined solely from mechanical reasons.

Each complete coil contains six conductors, by conductor meaning one side of a single coil. There are, therefore, 480 conductors in the winding. The complete coil has a "throw" of one and thirteen, *i. e.,* one side of a coil is placed in the bottom of slot No. 1, and the other side of the same coil is placed in the top of slot No. 13.

Fig. 1 shows the armature slot containing six conductors. For convenience in explaining the diagram of the connections of the winding the conductors in the slot will be numbered in the order shown. The three conductors of the bottom side of the first coil will be 1, 3 and 5. Fig. 2 shows the connections of part of the winding. Conductor No. 1, in the bottom of slot No. 1, is connected by the rear cross-connection of the coil to conductor No. 74, in the top of slot No. 13. This conductor is connected by the front connections and through a commutator bar to conductor No. 3, in the bottom of slot No. 1, adjacent to conductor No. 1. Conductor No. 3, in turn, is connected on the rear to conductor No. 76, which is adjacent to conductor No. 74. This method of connection is continued until the entire armature winding is completed. This type of winding is simple and flexible in its requirements. With two coils per slot any number of slots may be used, although it is usual to use a number which is a multiple of the number of poles, so that there will be equal numbers of conductors in the different circuits of the winding. In designing the winding the throw may be varied within the limits, it only being necessary that the throw shall not differ much from the number of slots divided by the number of poles, in order that the two sides of the same coil shall not lie under poles of the same polarity. With any particular armature, however, the throw can not be changed from the designed throw without affecting the performance of the machine.

The distinguishing characteristic of this type of winding is that the armature circuit between any two adjacent brushes is composed entirely of conductors under two poles. This is shown diagrammatically in Fig. 2.

The effects of this arrangement are:

1, There are as many separate circuits in the armature as there are poles, these separate circuits being connected in parallel by cross-connecting rings on the brush-holders. This characteristic gives the winding its name—multiple circuit.

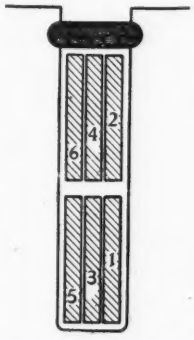


Fig. 1.—Arrangement of Conductors in Slot.

2. Each of the separate circuits generates independently the total voltage of the generator by the action of the magnetic flux from only two adjacent poles. In this respect, a multipolar generator, say, of six poles, is analogous to three separate two-pole generators connected in parallel and having the same number of conductors in series between brushes.

Balancing rings are connected to the winding at the commutator end. The rings are made of rubber-covered cable, held in position by brass clamps bolted to the armature spider. Short pieces of cable connect the rings to the proper commutator necks, these necks being specially formed to receive the cable connections. There are eight rings, each connected to three equidistant bars in the commutator. These connections are shown in Fig. 3, each circle representing a balancing ring, and the numbers, the number of the commutator bar to which the ring is connected.

The commutator is first tested completely around its circumference for short-circuits between adjacent bars at a voltage of 300, and for grounds at 2,100 volts, both alternating current. This latter test is made by winding a thin copper wire tightly around the commutator and then applying one terminal of the test leads to the armature core and the other terminal to the copper wire. Each armature coil is also tested for short-circuits at 250 volts, alternating current, before being put on the armature core.

When these preliminary tests have been made the core is ready for winding. A piece of cloth is wrapped around the inner edge of the commutator to prevent solder from dropping on the bars behind the commutator necks, causing short-circuits between bars.

Paraffined paper cells are placed in the slots to protect the insulation of the coils while winding. In placing the coils the winder stands with the commutator end on his left hand and holds the short side of the coil toward him. The short side of the coil is placed in the bottom of slot No. 1, being driven in place by a fibre drift and rawhide mallet. The long side of the coil is placed in the top of slot No. 13. The leads of the coil are placed in the proper commutator necks and the ends of the coil trued up. The winding proceeds in such a direction that the top of the core is turned away from the winder. To put in the short sides of the last twelve coils, which are placed in the bottom of the slots, it is necessary to raise the long sides of the twelve coils first placed on the core, slipping the last coils in under those already on the core.

When all the coils are in position the projecting tops of the paraffined paper cells are folded over the slot and cut off, and fibre wedges are driven in over the coils. The wedges are in halves, the two halves being driven in from opposite ends of the armature.

At this point the winding is tested for grounds by applying 1,800 volts, alternating, between the commutator and the core.

Hard wood wedges are driven between the commutator necks. This makes the commutator necks rigid, so that the coil leads can be cut off flush with the outside edge of the commutator neck. Pieces of copper strips as thick as the strap from which the coils are made and of suitable width are driven in the commutator neck between the upper and lower rows of leads

to fill the space between the upper and lower sides of the coils.

The coil leads are now about one-sixteenth of an inch below the tops of the commutator necks. With a flat chisel the top corners of the necks are pinched together and thus hold the leads in position and prevent the solder from running out. With a pointed drift about one-half of the wedge is split and driven out and the remaining half is driven down below the tops of the commutator necks, this be-

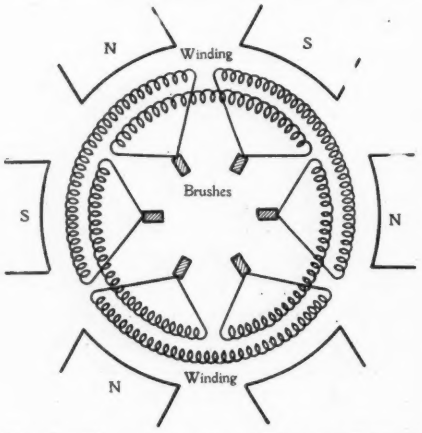


FIG. 2.—CONNECTIONS OF A MULTIPLE-CIRCUIT WINDING.

ing done to give more room to work in and to prevent the soldering flame from burning the wood.

In soldering a small pointed blast flame is directed on the neck to be soldered, a strip of sheet iron being placed between the necks to prevent the ones just soldered from becoming too hot. After the larger spaces in the neck have been filled with solder, the heat from the soldering iron

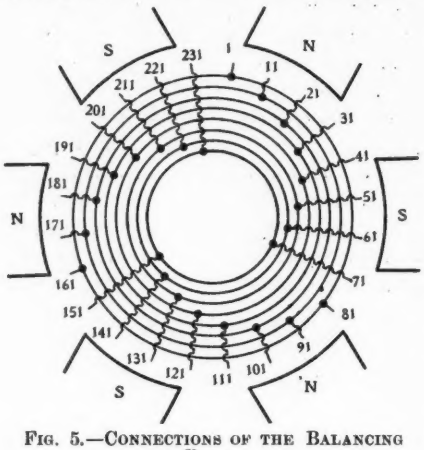


FIG. 5.—CONNECTIONS OF THE BALANCING RINGS.

is sufficient to keep the neck hot, while all the crevices in front and behind are filled, using a slender stick of solder. The cross-connections, which are in every tenth commutator neck and are below the coil leads, are soldered in as the process continues.

After soldering, all the half-wedges are driven out and new whole ones are put in, in order that the commutator necks can be turned down in a lathe. Practically no copper is taken off in this operation, so that the necks still extend about one-sixteenth of an inch above the leads. The commutator face is also turned down and sandpapered. The wedges are driven out and the soldered joints filed smooth by hand and the necks carefully spaced. The temporary cloth band, back of the commutator necks, is now removed with a wire hook, and after an examination for small particles of metal, the commutator is tested between bars for short-circuits at 110 volts, alternating.

The use of fibre wedges in the slots obviates the need of band wires on the armature core, but coils of this shape and size require a band on the rear end. This band is put on by rotating the armature in a lathe. Braid insulation is put on under the band wire and the band is kept in place by tin clips. The band is started nearest the core and works away from it; banding in the other direction would cause the outer end of the band to become loose.

The armature is statically balanced on a table. Ground and polished rings are put on the armature shaft, making a very sensitive bearing. Any unbalance will cause the armature to turn until the heaviest part is the lowest. When the light side is located the unbalance is corrected by casting the proper weight of babbit in some recess in the armature spider. If there is no suitable place for casting, the babbit is held in place by screws.

Balancing completes the construction of the armature.

The Times Wireless Telegraph System.

The London *Electrician* abstracts a letter published in the *Times* (London), recounting some of the troubles met in installing the De Forest wireless telegraph system at Wei-hai-Wei and on the steamer Haimun. Some of the apparatus was slightly damaged in transportation, and upon arrival there were no facilities for repairing nor for getting any work done. The material for the pole was very poor, and it took several weeks to raise a pole 170 feet high. The materials used for the pole were old junk masts, as the country in that locality is almost devoid of wood. The topmasts fitted on the boat at Shanghai went down the first night out, but another mast was fitted up while the Haimun was coaling in Japan. As there is but one topmast, wires can only be run straight up and down, and not across from mast to mast.

On the boat the system is grounded to the hull. There is a four-wire antenna less than 100 feet high. The pole on the shore gives an antenna 150 feet long. The site is on the top of a cliff about 150 feet above the sea. The writer says that the country is full of wireless, and there is any amount of competition, though not in press work. All the British warships, from the third-class cruisers up, are equipped with Marconi apparatus, and there are about twenty-four in all. Nearly all the Japanese ships have wireless equipments. The Russian ships are equipped, and also several German vessels. One or more or them can be heard at any time, night or day. The Japanese messages are particularly numerous, but they have given no trouble to the *Times* system, as the messages of the latter can be made very weak by a proper arrangement of the antenna wires on the ship. Without this arrangement the De Forest signals are received sharp and clear. If all four wires are disconnected, the De Forest signals are faint, and the Japanese calls are loud. Three wires are best suited for receiving up to 100 miles. Above 100 miles the De Forest signals come in best with two wires grounded directly. This allows other signals to come in, but not strong enough to interfere with the reading.

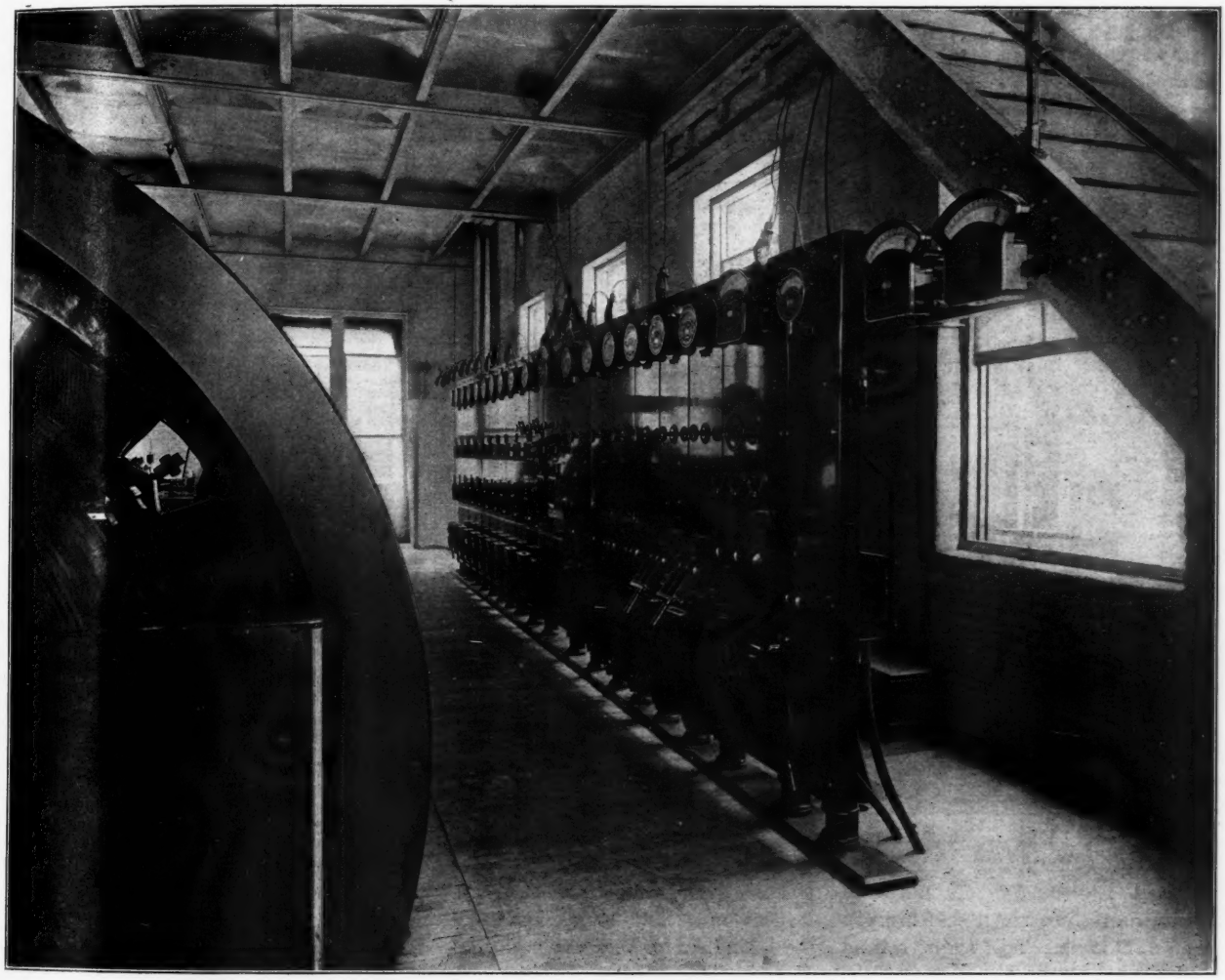
Water, Gas and Electric Light at Danville, Va.

The annual report of the superintendent of the water, gas and electric light departments of the city of Danville, Va., for the year ending December 31, 1903, has been received. The report of the gas department shows that the amount of gas used was greater than for the preceding year, although the output of the works was less; the difference being due to less loss. The expense of running the gas works also decreased. The city of Danville owns its electric lighting plant, as well as the gas works. The record for the former department during the year covered by the report shows that the operation of this plant was satisfactory. By the new system of keeping accounts, the electric light department is charged with running expenses and four per cent upon the value of the electric light property and the value of the water power property owned by the city. It charges the city for the municipal lights. At the close of last year there was a balance of $2,415.53 in favor of the department. Steps are now being taken to increase the output of the plant by the addition of a 150-horse-power steam plant, for which the expenditure of $8,000 has been authorized by the city council. This work is now well under way. The material has all been delivered, and the new plant will be ready to run in a short time. This addition will enable the electric light department to take care of expansion in this department for some time to come.

ELECTRICITY AT THE WASHINGTON NAVY YARD.

BY J. E. PRICE.

The biggest job of its kind in the world is now on foot at the Washington navy yard. This is the work of equipping the gun lathes in the big gun shop with electric drives, and making other improvements with electric outfits, thus supplanting the wilderness of shafting, belting, wheels and other connections of the steam machinery used.



THE SWITCHBOARD OF THE PRESENT PLANT AT THE WASHINGTON, D. C., NAVY YARD.

In connection with completing the electric outfitting of the various shops of the navy yard a new power plant is being built. This will furnish power for all the workshops, excepting the model-making shop, which has a plant of its own, that also furnishes current for operating the towing carriage of the model-testing tank.

The new power-house is 165 feet long by 100 feet wide; it has two brick chimneys, each 204 feet high, and when in use will have a boiler capacity of 6,000 horse-power. The engine equipment will consist of four 500-kilowatt, 244-volt, direct-current generators, at 120 revolutions per minute, direct-connected to vertical cross-compound engines. One of the improved features of the new power-house will be its method of obtaining water. This will be brought over a distance of 600 feet from the eastern branch of the Potomac river, by gravity through a thirty-six-inch conduit which will lead to a well. The system will be economical, as it will do away with the necessity for suction pipes; and an abundance of water can be had at all times.

The electric plant now in use in the yard is entirely capable for present work, but when the steam-operated machinery gives place to the electric movement, the power afforded will not be sufficient. The plant consists of four engines with a combined output of 1,325 horse-power, two of 300 horse-power, cross-compound, Ball & Wood, at 250 revolutions; one tandem-compound, 125 horse-power, at 300 revolutions, and one McIntosh & Seymour of 600 horse-power, at 130 revolutions. The smaller ones are direct-connected to two generators on the Edison three-wire system. The boiler service is equal to about 2,500 horse-power.

The present electric plant supplies light and power, the number of lights consisting of 6,000 incandescent and 450 arc lamps. There are seventeen electrically operated traveling cranes in the shops and 152 motors. The largest crane is of 110 tons capacity; the smallest, ten tons. Some of the motors are mounted in the galleries and connected to shafting; others, especially in the shops where small fixings are finished, are mounted on or connected at the floor with machines.

Under direction of Mr. C. E. Reid, chief electrician of the navy yard, the work of installing the new apparatus for operating the big gun lathes is being carried on as fast as such a large undertaking could be expected. There are eight of these lathes distributed over the 1,000 feet of length of the main gun-building

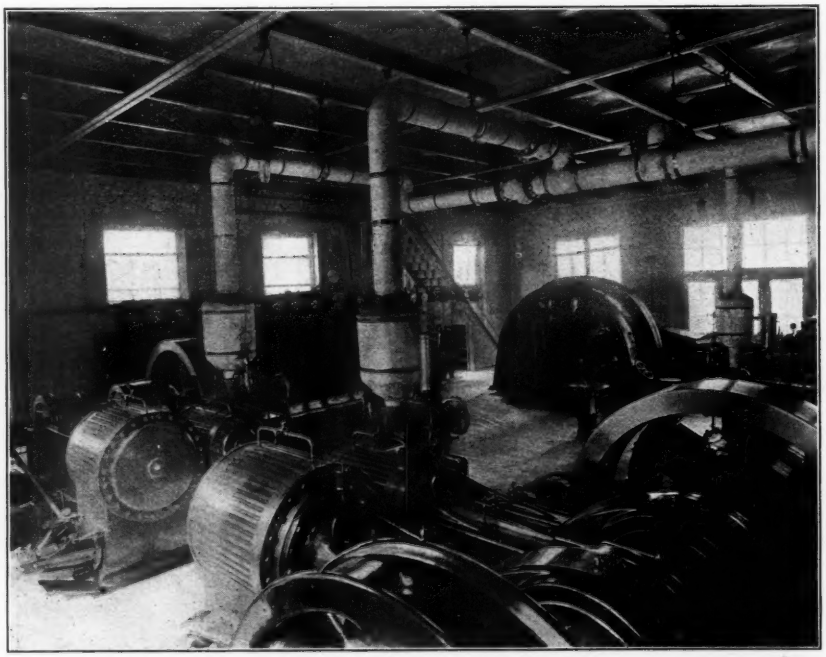
shop, and each takes up about fifty feet in distance across the eighty feet of width of the building. These lathes are ponderous and require for movement an aggregate of 850 horse-power. By the new arrangement of a multi-voltage system, each lathe will receive current for fifty-six horse-power. The armature of the main driving motor will be mounted on a bronze sleeve which will run on the present cone shaft. A ten-horse-power motor will also be employed on each lathe for moving the tool carriages which hold the tools used in gun trimming and polishing.

When the gun shops get their full electrical equipment there will be only three shops in the Washington navy yard not completely outfitted in this respect; but these now have electric cranes and some other electric features. All shafting will be done away with. The use of belting as still continued, in a number of the shops, has its marked disadvantages. It takes up room that could be otherwise employed; it is in this way, causing delay in the movements of men and material; and a particularly objectionable feature of this method of drive is in the fact that when a main belt breaks the whole machine work of the shop must be stopped until repairs are made.

The work of this navy yard has increased to such an extent that now there is not room enough in which to carry all of it under cover. At present work on ammunition hoists is being done outdoors. There is, since the addition to the acreage of the yard, plenty of space for much needed buildings, and Congress would hasten the effectiveness of the navy by appropriating for such.

This navy yard is a most important factor in the making of a great navy for this country; from it are sent guns of various sizes (the largest being of twelve-inch calibre forty-five feet long), gun carriages, projectiles, ammunition hoists and other finished material.

The Washington navy yard has grown as the navy has grown; and it began almost with the beginning of the navy. Congress on February 25, 1799, appropriated $1,000,000 for building six of the largest ships of war. That the object of this appropriation should be more speedily and economically accomplished, together with the design of creating a permanent navy, the navy department in the latter part of the year 1799 proceeded to apply a portion of this amount to the purchase and improvement of selected ground for six navy yards—one each at New York, Philadelphia, Boston, Portsmouth, Norfolk and Washington. The ground for the latter, originally consisting of forty acres, was bought for $4,000. A little over a hundred years later, the addition to this land, recently purchased, about forty-five acres, cost $100,000. As early as October, 1801, the government had expended $54,863 on the yard and by January 20 of the following year, timber for a seventy-four-gun ship, and other material for this yard had been purchased to the amount of $158,685.



THE ENGINE ROOM OF THE PRESENT PLANT AT THE WASHINGTON, D. C., NAVY YARD.

So it will be seen that the Washington navy yard began progressing early. But, about this time the advocates of a good, effective navy for the United States were surprised and angered by the action of Congress and the President. The legislative body passed the Peace Establishment Act, among other provisions of which the President was directed to discharge all the naval officers of the United States, except nine captains, thirty-six lieutenants and 150 midshipmen. The number of captains on the active list was twenty-eight. The act also authorized the sale of all ships and vessels belonging to the navy, except thirteen frigates, only six of these to be kept in commission, the remainder to be dismantled and laid up.

When this curious act was passed, Thomas Jefferson was president, and he had a theory that war was unnecessary, and that a powerful navy was a continual challenge to war. Later on, however, the navy and the navy yards began to grow, and to-day, in point of armament and execution, we have the best navy and the best ordnance factory in the world.

Storage Battery Locomotives for Switch Yards.

Quoting from a German writer, Herr H. Passauer, the *Mechanical Engineer* (London) says that the storage battery locomotive is specially useful in switch-yards, where a trolley would be difficult and expensive. Compared with steam in such service, it has the advantage of being always ready for service, and its cost of operation is smaller if the locomotive is used at irregular and longer intervals. The weight of the batteries is an advantage, since considerable weight is needed for adhesion. A storage battery locomotive has been built for switching purposes for the Prussian state railways. The battery consists of 200 cells, with a capacity of 184 ampere-hours at a two-hour discharge. It is charged once a day. Twenty cells are placed together in a wooden box, which is covered with an acid-proof insulating coating. These boxes are well insulated from each other and from the locomotive by means of porcelain rolls. For charging the batteries at 100 volts the cells are connected in five groups, each of forty cells in parallel. After the charge is completed the cells are connected in series, giving an average discharge voltage of from 360 to 410. The locomotive is charged at a constant current with a resistance regulation. Control is arranged for series parallel grouping. The total weight of the locomotive is 59,000 pounds, of which 22,000 pounds is the weight of the battery, and 9,500 pounds that of the other electrical apparatus..

Cincinnati Branch, American Institute of Electrical Engineers.

The Cincinnati branch of the American Institute of Electrical Engineers met on the evening of July 6 at the Grand Hotel. The members gave a banquet to Mr. Charles G. King, mechanical engineer of the Chicago Edison Company, who was giving a lecture illustrated by 100 slides on "The Installation of the 5,000-kilowatt Turbo-Generators of the Commonwealth Electric Company." The banquet was attended by some forty members and guests, the lecture being attended by about sixty. The meeting was presided over by Mr. B. A. Behrend, chairman; Mr. L. E. Bogen, secretary and treasurer. Before introducing the speaker, the chairman addressed the local members, calling their attention to the Union Engineering Building, and asking them to take a broad view of the question, representing to them the advisability of contributing toward the building fund. A motion was made by Mr. E. M. Gerry to appoint a committee to solicit subscriptions from the local members toward the building fund. This motion was seconded by Mr. Thomas S. Allen and was unanimously carried. A committee of three will be appointed to solicit such contributions.

The chairman introduced the subject, speaking of the importance of the steam turbine and of the wide field that it had already conquered, saying, in part:

"It is true of everything in industry as in life, that it can survive only if it is fitted to all the manifold conditions and requirements, and as many of these requirements are more or less conflicting with one another, the survival of the fittest means by a slight change of phraseology, rather the survival of the least unfit.

"The large reciprocating engine has held a wide field. It has been used to propel all the large fleets of the world; it has been used to drive rolling mills which manufacture steel, which is the basis of all industry; it has been used to operate the machinery in mines and collieries, which furnish the very element of civilization, coal. In all the large mills and factories of the world, the reciprocating steam engine has been used in electric power stations in connection with electric generators. The application of the steam turbine to the driving of electric generators is at present commanding our most careful and thoughtful attention; already the steam turbine has been adopted for the propulsion of some of the largest and fastest boats on the ocean which the Cunard line is preparing to launch. Such radical changes in our prime movers as are introduced by the steam turbine affect and strike at the root of the foundation of heavy electrical engineering. Remember that our 5,000-horse-power units, direct-connected to reciprocating engines, turn seventy-five times in one minute; the 5,000-horse-power steam turbine turns over 500 times and 750 times in one minute. Instead of huge generators twenty and thirty feet in diameter turning over at a slow rate of speed, we are building small generators six and eight feet in diameter, the surface speeds of which equal three miles a minute. New problems are crowding in upon the electrical engineers to take care of the difficult problems set by the necessity of running machines at such terrific speeds. Material which was good enough in the slow-speed generators for reciprocating engines would be worse than useless in the turbine generators, as it would yield at the high stresses and fly asunder.

"Strange to say, fifteen years ago we came to the engine builders and asked them to speed up their engines to make them with more revolutions per minute, and the steam engine builder complained and said that he could not do it, that he was 'up against' it, that his large engines would not run much faster than sixty and seventy revolutions per minute. Strange to say, it appears almost like malice of fate, the steam engine builder comes to us now and he wants us to run our generators faster and ever faster, and now it is for the electrical engineer to complain that the steam engineer is setting him too high a speed for his work.

"I repeat what I asserted that the steam turbine has won the day. The design of the steam turbine and the steam turbine generator requires all the knowledge of thermodynamics and of the theory of elasticity that has been obtained by men of science and engineering; they require for their manufacture the most refined methods of workmanship; the crude methods of manufacture, the unskilled labor employed in the manufacture of the slow-speed reciprocating engine and generator, have to give way to refined methods guided by scientific principle.

"As ever in the development of engineering, rule of thumb, prejudice and crudeness on the part of those that are mere followers and never leaders have had to make room to refined skill, so it will be with the steam turbine and generator. We are not now concerned with the relative advantages and disadvantages of the several fundamental types of steam turbines. We are not now concerned with the question of whether a vertical turbine is preferable or inferior to the horizontal type; we have seen that the reciprocating engine has found a wide field both as vertical and as horizontal engine, and, reasoning from analogy, a great future may well be predicted for the steam turbine. Justly are we interested therefore to-night in the description of the installation of the first large steam turbine plant of this country."

Mr. King described the installation and erection of the first 5,000-kilowatt steam turbine of the two-stage type, graphically illustrating the subject by means of very good pictures.

A discussion was opened by the chairman and was participated in by Messrs. Ryland, Pomeroy, Van Phul, Senstius, Allen and Wessling. The meeting was one of the most successful held by the Cincinnati branch.

The Substitution of Electricity for Steam on the Swedish Railways.

It is announced in the *Journal des Transports* (Paris) for June 25, that the Swedish government is considering seriously the introduction of electric traction on the state railways system, utilizing for this purpose the numerous waterfalls scattered throughout the country. Preliminary experiments will be made on a part of the Varta line, and a part of that from Stockholm to Jarfva. The power necessary will be supplied from the Stockholm station, and, in addition, a temporary station will be erected at Tomteboda, at an expense of 75,000 crowns ($20,000). Four companies have already offered to undertake the experimental work, these being the Siemens-Schuckert Company, the Société Allgemeine Elektricitäts, of Berlin, the Oerlikon Company, of Switzerland, and the British Westinghouse Company.

A Correction.

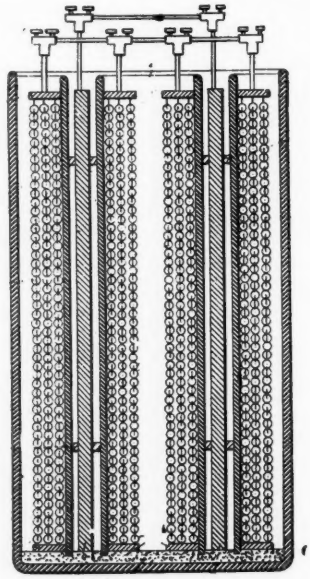
In a personal mention in the issue of the ELECTRICAL REVIEW for July 2, it was stated that Mr. S. P. Grace had been granted the honorary degree of master of engineering by the University of Michigan. This statement, although based on what appeared to be reliable authority, was incorrect. Mr. Grace received his first degree of bachelor of science from the University of Michigan some years ago, and this year he fulfilled all the requirements for the degree of electrical engineer, which degree was accordingly conferred. This degree is not honorary. —ED.

The Meeting of the London Physical Society.

At the meeting of the Physical Society of London, held June 10, 1904, a paper was read by Dr. J. A. Fleming, entitled "A Model Illustrating the Propagation of Alternating Current Along a Telephone Cable, and a Simple Theory of the Same." The first part of the paper is concerned with the presentation of the elementary theory of the propagation of alternating currents along a telegraph or telephone cable, expressed in terms of complex quantities. Beginning with the fundamental differential equations for the distribution of potential and current in an element of such a cable when traversed by any current, these are then thrown into the form appropriate for considering simple harmonic currents, and a solution is given for the potential and current distribution in the case of a semi-infinite cable having a periodic electromotive force applied at the end. A geometrical interpretation is given of this equation, which leads to a graphic representation of the difference of potential indicated at any moment. The model which illustrated the meaning of the equation deduced consists of a steel axis, on which are keyed a number of wooden discs grooved on the edge. These are set on the shaft eccentrically, and the eccentricity of the wheels diminishes in geometrical progression. Each eccentric is shifted backwards in phase, compared with its preceding neighbor, by an equal angle, and these eccentricities and phase angles can be varied. Each eccentric wheel is embraced by a long string, the ends of which are attached to metal blocks which can slide up and down the steel wire. The strings are all of equal length. When the axis carrying the wheel revolves, each block moves up and down with a nearly simple harmonic motion; but the amplitude of that motion decreases from block to block, and the phase of the motion of each block is delayed behind that of its next preceding neighbor by an equal amount. When the axis is turned round, the blocks are arranged in a periodic curve of decreasing amplitude, and move up and down in a manner which imitates the propagation of a wave of alternating current or potential along a cable. The question of distortion in a cable is then taken up, an allusion being made to the various methods of diminishing this, with particular reference to Dr. M. I. Pupin's system. The suggestion was made that there is no difficulty in applying this plan to subterranean telephone trunk lines.

A New Process for Carbon Battery Electrodes.

Mr. Pierre Joseph Kamperdyk, of New York, N. Y., is the inventor of an electric battery, relating more particularly to the construction of the carbon electrodes and their disposition relatively to the other parts of the cells. A containing vessel of rectangular form is employed, and three porous cups having their lower ends enclosed by embedding them in a layer of suitable cement in the bottom of the vessel, but which may be of any approved form and of suitable material. The outer cups have the side omitted next the adjacent wall of the vessel, and all are held in position by distance-pieces, placed between them, and provided with openings in which the negative-pole electrodes, which are two flat zinc plates, are received and held close to the walls of the cups,



ELECTRIC BATTERY.

but out of contact therewith. The cups are supplied with a depolarizing liquid and the surrounding space contains the exciting liquid in which the zinc plates are immersed. A positive-pole electrode is presented to each face of each zinc plate, the central cup containing two positive-pole electrodes and the porous cups each containing one. In all the prior forms of carbons, the resistance offered to the passage of the current from a given point in the mass to the pole or metallic conductor increases in proportion to the distance traversed and is due to the specific resistance of the material. The object of the present invention is to reduce as far as practicable the distance to be traversed through the mass. This is accomplished in several ways. Fine filings of incorrodible metal may be added to the carbon in the mass, or wires of any conducting metal may be introduced and protected against corrosion by dipping the carbon thus constructed in metal paraffin, thus closing the pores and protecting the wires, or wires of incorrodible metal may be used, or wires of copper or other good conducting metal covered with a plating of incorrodible metal, or a combination of two or more of the above methods may be used together. Copper wires are employed, which are coated with an incorrodible metal, as platinum, enclosed in small masses of carbon. The wires are joined at the upper and lower ends to copper plates which, with the points of attachment, are protected against corrosion by a deposition of lead or by a coating of cement, preferably having bitumen or gutta-percha as its base. The carbon electrodes rest on the layer of bitumen or other cement in the bottom of the vessel and stand as near as possible to the walls of the cups so as to reduce as much as possible the distance between the carbons and zincs and correspondingly lessens the internal resistance of the cell. The small masses of carbon, which are shown as balls perforated diametrically and strung like beads on the wires to form slender pencils, are arranged in rows parallel with each other and with the face of the zinc plate, and the several upper plates are connected together by wires to form the positive pole of the cell. The balls rest upon another and preferably fit snugly on the wires to ensure contact. Each pencil is closely adjacent to the next in the same row and to its immediate neighbor in adjacent rows, but are held sufficiently separated to permit the depolarizing liquid to circulate freely.

The World's Fair Souvenir of the Engineers' Club of St. Louis.

The Engineers' Club of St. Louis, Mo., has issued for the benefit of its members and the engineers who may visit St. Louis during the exhibit a valuable World's Fair souvenir. This is divided into sections as follows: (1) World's Fair section; historical, the site, general features, financing, engineering, the exhibit palaces. (2) Engineering guide to St. Louis and vicinity; civil, mining, mechanical and electrical engineering; general. (3) Local engineering data for St. Louis and vicinity. (4) Ninth annual bulletin of the Engineers' Club of St. Louis.

The West Shore Railroad has published a new series, detailing its service to the World's Fair, St. Louis. Mr. C. E. Lambert is the general passenger agent, 7 East Forty-second street, New York city.

BOOK REVIEWS.

"Grammar School Arithmetic." David Eugene Smith. Boston. Ginn & Company. Cloth. 394 pages. 5¼ by 7½ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at 75 cents.

The author of this book endeavors to adapt the advantage of the old-style teaching by the topical system, and its abundant drill, to a modern arrangement, securing mental discipline through interesting problems, based upon every-day happenings, rather than through a meaningless juggling of figures.

"American Street Railway Investments." New York. The McGraw Publishing Company. Cloth. 400 pages. 9¾ by 13¼ inches. Supplied by the ELECTRICAL REVIEW for $5.

This volume is well known as the annual financial manual of street railway and traction companies. The present volume is somewhat larger than heretofore, and contains reports of a number of companies which have hitherto declined to make statements. The locations of power stations have been added, and repair shops, with parks and pleasure resorts. More attention has also been given to information concerning the funded debt of various properties. A number of maps in colors have been added, and a buyer's manual is also incorporated.

"Moody's Manual of Corporation Securities, 1904 Edition." New York. Moody Publishing Company. Cloth. 2,464 pages. 6 by 9½ inches. Supplied by the ELECTRICAL REVIEW, cloth, $10; full flexible leather, $12.

The present work is so large that it makes a rather bulky single volume. It contains statements of over 11,000 corporations, and directories of the members of all stock exchanges in the United States and Canada. Sections are devoted to steam railroad securities; guaranteed railroad and other stocks; gas and electric light companies; electric traction companies; water companies; telephone, telegraph and cable companies; mining and oil companies; banks, trust companies and industrial and other business corporations. A ready reference index makes easy the securing of this information.

"Concerning Type; a Handbook for Users of Printing." A. S. Carnell, New York. Flexible leather. 64 pages. 3⅛ by 6⅛ inches. Supplied by the ELECTRICAL REVIEW at 50 cents.

To one who has had but little experience in the selection of type for display advertising, and needs a quick reference with regard to the terminology of the practical printer, this little book will be welcome. Of course there is not room for the exhibiting of many different styles of type, but the main object is accomplished in showing, in typical instances, the comparison of the type-space required for the same word when set up in "condensed" or "extended" type, and for a paragraph set up in various sizes of type. The information is given in a brief, sketchy manner. The book makes no pretence at going to the subject as an artistic effort, but in a straightforward compendium on what a man who knows nothing should learn to get along better with his publisher.

Report of the Wire Department, Boston, Mass.

The annual report of the wire department of the city of Boston, Mass., for the year 1903, gives in detail the new construction and the reconstruction of electric conductors in that city. A number of new laws have been put into effect. One of these, relating to the use of guy wires in and over streets, has been of particular benefit. Underground construction work has progressed satisfactorily, and a large amount of overhead wire has been taken down and replaced by cables in the conduits. The work of the new laboratory has been very effective, solving many doubtful questions. The commissioner of wires, Mr. Patrick J. Kennedy, calls attention to the fact that, during the year, no fire has been found to be due to wiring which had received the approval of his department. He also calls attention to the need of providing for better inspection of old wiring. A table, giving in detail the amount of underground work for the year, shows that 557,419 feet of cable have been laid in 67,614 feet of conduit. There have been 506,452 feet of duct laid. This brings the total underground system of Boston, at the close of last year, up to 1,299,864 feet of conduit, and 8,332,483 feet of single duct. In these are laid 10,316,358 feet of cable. The total amount of power now available in the Boston stations is 128,616 horse-power of engines. This corresponds to 792,059 incandescent lamps and 14,001 arc lamps, and 12,344 motors with an aggregate output of 168,500 horse-power. There are 298 electric stations.

The report of the interior division, which deals with inside wiring, takes up the work of this department in regard to improving inside work. Considerable trouble has been caused by the failure of those in charge of isolated plants to conform to the laws. During the year the total insurance loss from fires known to be due to electricity was $36,952.50. Of this sum $35,591.81 was caused by five fires, the remaining fires being small, causing an average loss of $35.95 each. This division reports nine accidents during the year, none of which was fatal. The report contains drawings and a brief description of the new L street station of the Edison Electric Illuminating Company. There are also two maps showing the progress of the underground work in the city.

Work at the Department of International Research and Terrestrial Magnetism, Carnegie Institute.

The June issue of *Terrestrial Magnetism and Atmospheric Electricity* (Baltimore), gives a brief account of the work which has been planned for the department of international research and terrestrial magnetism of the Carnegie Institute for 1904. Besides the work of organization of the department, the compilation, discussion and preparation for publication of the data for the complete presentation of existing knowledge of the earth's secular magnetism over the entire globe, for the determination of the points at which it will be necessary to repeat observations at suitable intervals, for the successful scientific investigation and determination of the causes and their modes of action, and for ascertaining the proper corrections to magnetic charts, to refer them to a desired date, have been authorized and begun. These researches are a continuation of Dr. L. A. Bauer's studies. The department has been authorized also to take up the discussion and publication of the data on the magnetic perturbation observed during the eruption of Mont Pelée, Martinique, in 1902; further, the compilation, discussion and publication of the existing data concerning the variation of the earth's magnetism, other than the secular variation already provided for, and the perturbations of the earth's magnetism will be carried out. Authority has also been given to enable the department to make the necessary preparations for future observational work, and to take part in the observation of such of the earth's magnetic or electric phenomena of momentary occurrence as are of the highest importance to the advancement of our knowledge.

An interesting exhibit at the World's Fair, St. Louis, Mo., is a facsimile of the Empire State Express of the New York Central, a creation of the general passenger agent, Mr. George H. Daniels. On June 17, it is stated, 7,022 persons inspected the coaches and locomotive. Alongside the modern exhibit is the old De Witt Clinton, with its three quaint cars —the first train ever placed on the New York Central.

The Polytechnic Engineer.

The 1903-1904 issue of the *Polytechnic Engineer,* the annual organ of the Polytechnic Institute of Brooklyn, contains a number of exceptionally interesting and timely articles. Of these that on "The Factors Influencing the Economic Design of Single-Phase Railway Motors," by Mr. Oskytel H. Clarke, is of particular interest to the electrical engineer.

Comparing the two types of alternating-current railway motor now attracting attention in this country, the point is made that, in general, a straight series motor should be lighter than the repulsion motor. A motor embodying both a motor and a transformer in itself is naturally heavier than a motor alone. The repulsion motor requires a greater field current at low speeds than the straight series motor; hence the short-circuiting current at starting and at low speeds will also be greater, which will make commutation more difficult under these conditions. The fact that a straight series motor may be wound for a low voltage, and used with a separate transformer, while the repulsion motor can not, without increasing the weight of the equipment, is an advantage in favor of the series motor. There is another advantage in this respect, since the use of a separate transformer enables the equipment to operate at different trolley voltages.

The principal difficulty in commutating alternating-current motors has been the presence of local secondary currents in the coils short-circuited by the brushes. A realization that this difficulty may be overcome is what has drawn attention recently to the commutating type of alternating-current motors. In commutating types of single-phase motors the most important elements besides the speed characteristics are the efficiency and the power-factor. The efficiency of such motors will usually be less than that of a direct-current railway motor of the same output. Comparing these various losses, item by item, with those of a direct-current motor, it is seen that certain losses will necessarily be greater in the alternating-current motor than in the other type. Economies will not be effected by the single-phase system because of any advantage of the alternating-current motor over the direct current, but rather through the employment of an alternating current. The motor itself is merely a single element in the system, but it is such an important one that essential advantages may be gained by employing motors of the proper type.

Mr. Clark, who is the editor-in-chief, also contributes another article on electrostatic generators, which gives a brief historical sketch of these machines and the results of efficiency tests. The maximum voltage generated by the Holtz machine is not affected by the maximum of rotation of the plates, but increases as the distance between the discharge knobs is increased. It is also dependent upon the location of the spark-gap with respect to the large stationary balls attached to the collecting combs. The Holtz machine is reversible in its action in the same sense as a dynamo electric machine—that is to say, it will operate as a motor if supplied with electricity from another influence machine. No previous excitation is requisite. The efficiencies of several machines were determined by operating one machine as a generator, and driving a second from this as a motor. The power input to the generator was determined by measuring the power supplied to the driving motor. The output of the static machine running as a motor was determined by means of a strap brake. The following are some of the efficiencies obtained: with a needle-point gap of six inches, the useful output of the generator was 71,200 volts; the current, 0.000,482 ampere, equal to thirty-four watts; the efficiency, 27.1 per cent. With a spark-gap of twelve inches, the voltage was 122,000; the current, 0.000,319 ampere; watts, thirty-nine; efficiency, 22.2 per cent. With a gap of eighteen inches, the voltage was 180,000; current, 0.000,194; power, thirty-five watts; efficiency, 19.5 per cent.

Mr. John Morris Lloyd discusses variable-speed control, and Mr. Henry T. Lees describes a new gas turbine. In this machine the gas is burned under pressure, the products of combustion being supplied to the rotating part of the turbine through a hollow shaft. Passing out from this through openings in the side, the gas expands radially through the first disc. It is discharged from this disc into a chamber, which returns it to a second section of the hollow shaft. Passing through this it emerges through the second disc, and so on through as many stages as seem desirable. The theory of this turbine is treated thermodynamically.

A brief discussion of commutating single-phase series motors is contributed by Mr. Rolin W. Hutchinson, Jr.

The Society of Civil Engineers of France.

The April issue of the *Memoirs of the Society of Civil Engineers,* of France, contains a long discussion by M. J. Rey of the steam turbine, with particular reference to the Rateau turbine and its applications. M. Rey details somewhat briefly the history of the Rateau turbine, and classifies the various systems according to three considerations: by the number of movable parts, by the method of conducting the working fluid, and by the mode of operation of this fluid. Under the first classification we find turbines with a single movable wheel, turbines with multiple wheels and turbines with a single wheel subdivided. Under the second classification the fluid may pass through the turbine parallel to the axis, remaining practically the same distance from the axis of rotation, it may pass through the motor in a plane perpendicular to the axis, or a combination of these two may be used. In the third classification the working fluid may act by impact or by expansion. The various means of applying these different methods are taken up, the advantages and difficulties of each type being considered. A comparison is then made of the actual performance of the various types of steam turbine, efficiency curves being given.

Under the head of applications of the Rateau turbine, the driving of continuous-current machines, alternating-current machines, centrifugal pumps, feed pumps and ventilating fans is considered. The use of low-pressure turbines is touched upon, and, finally, the application of the turbine to marine propulsion. Under the latter heading a brief account is given of what has already been done in this field.

Selection of Architects for Union Engineering Building.

Since the middle of June the conference committee of the three national engineering societies and of the Engineers' Club has received twenty-six complete sets of competitive plans for the two buildings inclusive. This committee, as is well known, is charged with the responsibility of giving effect to the gift of Mr. Andrew Carnegie, of $1,500,000, for the erection of two buildings in New York city suitable for the relative purposes of the associations. With the assistance of Professor W. R. Ware as expert advisor, the committee has made a careful investigation of all the plans submitted. The successful competitor for the union engineering building is Mr. Herbert D. Hale, of Boston, with Henry G. Morse, of New York, as associate architect. The successful competitors for the Engineers' Club are Whitfield & King, of New York. It was the desire of Mr. Carnegie that the competition should be a mixed one, so that in addition to selecting six competent architects, the committee threw the work open to all comers and provided a prize scheme to compensate the best competitors in the open class. The successful competitors in the open class, for four equal prizes of $400 each, in addition to Mr. Hale, are Trowbridge & Livingston, of New York; Frank C. Roberts & Company, with Edgar V. Seeler, associate, Philadelphia; and Allen & Collins, of Boston.

HIGH-SPEED ELECTRIC RAILWAY EXPERIMENTS ON THE MARIENFELDE-ZOSSEN LINE.[1]

BY ALEXANDER SIEMENS.

On September 4, 1901, Mr. O. Lasche, of Berlin, read a paper on "A High-Speed Railway Car" before the engineering conference in Glasgow, which has been published in vol. xxxi of the *Journal* of this institution. Since that time three sets of experimental runs have been made with high-speed cars on the military railway between Marienfelde and Zossen, near Berlin, which had been equipped electrically for the purpose, and last autumn speeds of over 200 kilometres per hour were attained. Although further experiments are in contemplation, it may not be out of place to give a short history of the trials and of the preparation for them, as the main objects of the investigation have been accomplished.

The English patent 10,926/86, "improvements in the application of Volta inductors or secondary generators for distributing electrical energy and for regulating alternate-current motors, more particularly applicable to electric railways," communicated by Siemens and Halske, Berlin, forms a convenient starting point for such a narrative, as the Zossen experiments may be considered the latest link in the chain of development of the ideas enunciated in that patent. It is pointed out in the specification that "the use of Volta inductors or secondary generators for transmitting electrical energy offers the advantage of enabling a much higher tension to be employed than is possible with transmission by continuous currents, so that considerable energies can be transmitted through great distances by means of comparatively small conductors, while at the same time the regulation of the power of motion is capable of being effected much more easily." About the method of using the transformers in connection with electric railways, the specification suggests either to place them on the carriages or at certain distances apart along the line of rails. In the first case the primary coils are connected by rolling or sliding contacts to the conductor extending alongside the rails, which conveys alternate currents of high tension thereto; while in the second case the secondary coils of the transformers would supply low-tension currents to the working conductor and thence to the motors on the carriages. As motors, dynamo machines that can produce continuous currents are recommended, and various methods of regulating them are described. The results obtained with such motors at that time were, however, not very encouraging, chiefly on account of the high frequency of the currents employed, and no important practical steps were taken until the three-phase motors began to occupy the attention of electrical engineers.

In March, 1892, Mr. Wilhelm von Siemens gave instructions to have a short experimental line constructed at the works of Siemens & Halske in Charlottenburg, and try a twenty-horse-power, three-phase motor on it. The line was 360 metres long, with a curve of forty metres radius and seventy metres long about the centre, the whole line being practically level. The current was supplied by a fifty-horse-power, three-phase machine, type R. 32/26, and between two terminals of the same, a difference of potential of 500 to 600 volts was kept constant. At the end of July the motor car was finished, and it was successfully tried on August 2, when loaded with 3,000 kilogrammes. At starting the motor was connected triangle fashion, and afterwards star fashion, running at 1,400 revolutions per minute when the car was traveling at a speed of 22.5 kilometres per hour. The movement was transferred from the motor to the wheels by worm gear at the rate of eleven to one. Encouraged by the results, Messrs. Siemens and Halske formally applied, on October 29, 1892, to the government for permission to equip from forty kilometres to fifty kilometres of some imperial railway near Berlin, in order to investigate experimentally the possibility of working the ordinary railways by means of electricity. They proposed to place transformers along the line, from which a low-pressure current would be supplied to the cars, and they explained their desire for such a long line by their intention to run the cars at a speed of from sixty kilometres to seventy kilometres per hour. On November 12, 1892, the government declared its readiness to take the proposal into serious consideration after the experimental line had been inspected by experts. Their visit took place on December 2, but on December 22 the application was declined, as the experts had not been satisfied with the method of collecting the current from the conductor along the line. In the experimental line two overhead wires were used, the rails forming the third conductor, and the government experts, as well as some of the engineers of Messrs. Siemens and Halske, considered such a system as inapplicable to full-sized railways. The consequence of this attitude was another long pause in the development, until five years later, when Mr. Wilhelm von Siemens initiated further experiments, in which, however, high-tension currents were to be supplied to the car. His view was that, for great distances, the weight of the collectors had to be kept as low as possible, and that they would, for this reason, not be suitable to carry heavy currents; consequently, the tension had to be kept as high as circumstances would permit in order to allow sufficient energy being transmitted to the car.

A waste piece of land near Gross Lichterfelde was placed at the disposal of Messrs. Siemens and Halske by the parish, and they built a short line, about 1,800 metres long, of normal gauge, in 1898, equipping it with three overhead conductors for three-phase current of either 750 or 2,000 or 10,000 volts. At first the conductors were carried by insulators, each fastened to a movable wooden arm, and the current was collected by a horizontal bar, turning round a horizontal pivot and pressed by a spring from above against the conductor. When the speed of running was increased, these horizontal bars jumped at the insulators and caused so much sparking that this arrangement had to be abandoned. In rebuilding the line the three conductors were placed vertically one above the other, at a distance of one metre, and the insulators to which they were attached were supported by an elastic cord stretched between the two ends of a channel iron, bent in the form of an ellipse and fastened to the poles. The collectors were also modified, each consisting of a horizontal arm, turning round a vertical pivot, and carrying a vertical bow sliding along the conductor, a spring pressing the arm against the conductor. This arrangement was eventually found satisfactory for the highest speeds attained. While it was possible to settle by the experiments on this short line a suitable form of collector and a reliable construction of the overhead conductors, it became obvious that for trials at greater speeds the assistance of the railway department of the government was indispensable. In the course of negotiations to obtain this the scope of the proposed trials was widened in so far that the cooperation of other firms was secured by the formation of the "Studiengesellschaft fuer elektrische Schnellbahnen," on October 10, 1899. This syndicate consists of the Deutsche Bank, Delbrück Leo & Co., National Bank, Jacob S. H. Stern, A. Borsig, Phil. Holzmann, Fred-

[1] Paper read before the British Institution of Electrical Engineers on May 26—Slightly abridged.

erich Krupp, v. d. Zypen & Charlier, Allgemeine Elektricitäts Gesellschaft, and Siemens & Halske. The war office placed its single line between Zossen and Marienfelde at the disposal of the syndicate, and the president of the imperial railway office became its chairman. Each year the syndicate has published a report of the trials of the preceding year, and all the data given in this paper are taken from these official reports unless another source of information is specially mentioned.

The permanent way of the military line consisted of rails weighing 33.4 kilogrammes per metre, placed on iron and partly on wooden sleepers, and its condition was such that no greater speed than eighty kilometres per hour was allowed on it. In the first instance this was improved by relaying about 800 rails of twelve metres each, increasing the number of sleepers by 4,000 and adding broken stone ballast to the extent of 4,000 cubic metres. This work was finished and the line, twenty-three kilometres long, ready for the trials on September 3, 1901, when the official inspection was satisfactory. At the same time electric contacts to be actuated by the wheels, were placed at 500 metres distance from each other all along the line, and a registering apparatus at Mahlow station was connected to them, so that the speed of the cars could be verified there. The overhead conductors along the line were constructed by Siemens & Halske, practically in the same way as the line at Gross Lichterfelde, with a device added to earth the line in case a conductor should break. At every insulator a metallic loop, about thirty centimetres in diameter, extending horizontally toward the pole, is connected to the conductor, and a vertical copper wire passes through the centre of the loops, the copper wire being efficiently connected to the running rails and through them to the zero point of the three-phase generators, the rails being, in addition, connected to metal earth plates at intervals of one kilometre. Any interruption of a conductor brings it, therefore, at once into contact with earth, and prevents any accident by shock from the falling conductor. The efficiency of this arrangement was tested, both intentionally and by an accident, when the conductor fell on an official, but in both cases the earthing served as an absolute protection. The line is fitted at every kilometre with means of adjusting the strain, kept at about 1,000 kilogrammes, and with lightning discharges of the horn pattern. At a distance of about one kilometre from Marienfelde (8.5 kilometres) the feeding line from the generating station Oberspree, thirteen kilometres distant, and built by the Allgemeine Elektricitäts Gesellschaft, is joined to the line along the railway by a main switch.

Two carriages were built for the trials by v. d. Zypen and Charlier, of Cologne, constructed and fitted as corridor carriages in accordance with the rules of the German Railway Union. One of these cars, called "A," was furnished with its electrical outfit by the Allgemeine Elektricitäts Gesellschaft, and has been described by Mr. Lasche as stated above, while the other was fitted out by Siemens & Halske, and has been described by Dr. Reichel (*Elektrotechnische Zeitschrift*, 1901, page 671); in the reports the latter is called "S." Both cars carry the collectors, tested and approved of in the experiments of Siemens & Halske at Lichterfelde, with this modification, that in the "A" car each collector is carried by its own standard, while in the "S" car one standard carries all the three collectors. There are two groups of three collectors on each car. These cars were delivered on the experimental line in the beginning of September, 1901, and at first were drawn by locomotive so as to ascertain whether all their parts, especially the brakes and springs, were properly adjusted, and to study the mechanical behavior of the collectors and conductors. Observations were also made as to the relative movements of the bogies and the carriages. A final inspection was made on October 1, and the permission to start running the cars by electricity was given on fully and minutely prescribed conditions.

On October 3 and 4, 1901, the conductors along the line were officially inspected and tested under pressure, and on October 7 the electric current was for the first time turned on to the cars. The technical committee of the syndicate had settled on September 24 that the trials should be undertaken in such a manner as to ascertain—(1) The highest safe speed on the line. (2) The proper construction of the permanent way. (3) The most advantageous construction of the car. (4) The most suitable electrical outfit. (5) The amount of energy at the various speeds. (6) The cost of working.

To obtain the necessary data, each car has been fitted with the following instruments: (1) A speed indicator for the driver. (2) A speed-registering apparatus. (3) An acceleration indicator. (4) A voltmeter. (5) An ammeter. (6) A wattmeter. (7) A phase indicator. (8) A pyrometer. (9) Air-pressure indicators.

The speed indicator registers the kilometres per hour, and is checked by the speed-registering apparatus on the car and by the instrument at Mahlow station, where the position of the car is indicated every 500 metres by the wheel contacts along the line. Of the greatest importance are the observations in connection with the brakes, both as regards the time and the distance taken to bring the car to a standstill after it had attained certain speeds. At the generating station in Oberspree suitable instruments for registering volts and amperes were connected to the feeder, so as to check the apparatus on the cars. Four sets of trials were to be run:

(1) Starting and braking experiments up to a speed of 100 kilometres per hour. The generating station to supply current at twenty-five periods and the motors to receive current only long enough to attain the prescribed speed, when the current is to be cut off and the brakes are to be applied. (2) Running at an equal speed, with current of twenty-five periods, first from station to station and afterward along the whole line, with resistances in circuit so as not to exceed the prescribed speed. (3) Similar experiments as under (1) and (2), but with currents of higher periods for speeds from 100 kilometres to 130 kilometres per hour. (4) Running with currents of forty-five periods at speeds exceeding 130 kilometres per hour.

The two cars were to be used on alternate days, and no increase in speed was allowed unless everything had worked satisfactorily at the last speed.

On October 8, 1901, the "S" car made its first run between the car shed and 10.5 kilometres, but while the current was on the signaling apparatus of the state railway and of the military line were sufficiently affected to require the construction of metallic returns along the whole line. This was finished in time for the regular runs of both cars to commence on October 14, and they were continued until November 30, with the exception of twelve days, during which the permanent way had to undergo extensive repairs. During these trials the cars ran about 3,000 kilometres, of which 2,200 kilometres were under current, and for 800 kilometres the cars were pulled by locomotives before any current was used. The first two sets of experiments were carried out according to programme, and dealt with speeds up to 130 kilometres per hour, and they were principally utilized to ascertain the rate of acceleration and

the data of braking. During the third set the speed was gradually increased until the "S" car reached a speed of 160.2 kilometres per hour on November 5, while the railway officials made an inspection of the line in accordance with the regulations governing the trials. Even at a speed of 140 kilometres the running of the cars became irregular owing to the condition of the permanent way, and at higher speeds the rails were bent and their level was so much disturbed that the speed of the subsequent runs had to be restricted to 130 kilometres per hour. It was, however, possible to make valuable measurements of the energy required, and the working of the collectors and conductors could be observed with currents of forty-eight periods and 13,500 volts. About the behavior of the various component parts the report of the syndicate enters into great detail, of which a short summary only is given. At the generating station the steam dynamo and transformers worked quite satisfactorily, and supplied current of twenty-five to fifty periods and 6,000 to 14,000 volts. The feeder consists of four conductors, each of fifty square millimetres section, the fourth conductor connecting the running rails to the zero point of the two transformers. The conductors along the line, constructed as described above by Siemens & Halske, have given no trouble whatever, even in heavy rain or hoar frost. One of the most important problems—namely, to ascertain how large quantities of energy can be transferred from a standing conductor to a rapidly moving car—has been successfully solved by the construction of the conductors and of the collectors, both of which were the outcome of the experiment at Gross Lichterfelde. Both carriages, built by Van der Zypen and Charlier, ran in a very satisfactory manner, and ran steadier at a speed of 120 kilometres to 130 kilometres per hour than an ordinary corridor train carriage at ninety kilometres per hour. At higher speeds the irregularities of the permanent way made the running dangerous. In the two articles mentioned above the electrical arrangements of the two cars are described in detail.

The report of the syndicate makes the following observations: (*a*) it considers the switching arrangements of the "S" car more complicated than those of the "A" car, and suggests for both cars that it should be possible from either end to set both groups of collectors simultaneously; (*b*) the transformers in both cars are cooled by air, and have worked well during the trials. In car "S," after running 230 kilometres in succession, necessitating fourteen accelerations to a speed of 120 kilometres per hour, the temperature of the transformers was only twenty-five degrees centigrade; they were, therefore, considered sufficiently large to stand long runs, especially as they worked well with 12,000 to 13,000 volts. On the other

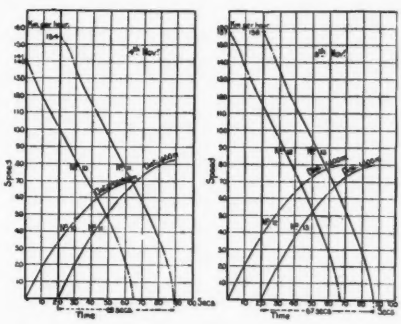


FIG. 1.—RESULTS OF BRAKE TESTS ON THE MARIENFELDE-ZOSSEN LINE.

car the transformers were much lighter, but they were never overheated, only on November 19 a primary coil was short-circuited by a current of 12,000 volts. After that date currents of no more than 8,000 volts were permitted, so that the point could not be settled whether the transformers on this car could be used for long periods with high voltages; (*c*) each of the motors on both cars is designed for 250 horse-power, the "A" car motors taking current at 435 volts, and the "S" car motors 1,150 volts, while the pressure in the secondary circuit is 650 volts when standing still and during acceleration. No difference in running was experienced, although the motors on the "S" car are rigidly fixed to the axles of the wheels, while the motors of the "A" car are

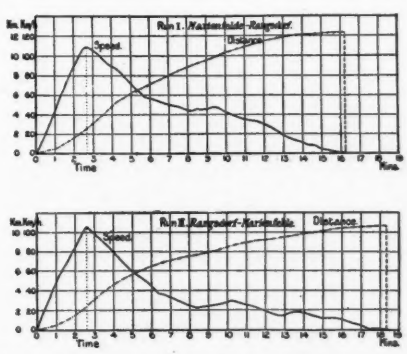


FIG. 2.—CURVES SHOWING RETARDATION DUE TO CAR FRICTION ALONE.

carried by the bogie frame and drive by an arrangement of springs. The report prefers the latter arrangement, and suggests trying a third method—driving the wheels by connecting rods; (*d*) the switches and resistances present another feature in which the electrical arrangements of the two cars differ; on the "A" car liquid resistances were employed, regulated by pumps, while metallic resistances were carried on the "S" car. Both arrangements gave no trouble during these trials. The metallic resistance switches are more complicated than the others, but they work faster. Of great importance are the results obtained while accelerating and during the retardation of the cars. The acceleration varied with the demand on the generating station and the motors, as was to be expected. To obtain a speed of 100 kilometres per hour the distances traveled varied from 2,000 to 3,200 metres, and the times from 138 to 220 seconds. These figures correspond to an average acceleration of 0.13 to 0.2 metre per second, and correspond to 700 horse-power to 1,000 horse-power. As the motors are capable of exerting up to 3,000 horse-power during acceleration, this might have been increased correspondingly, but the generating set was not powerful enough to supply the necessary current. For trains intended to travel long distances without stops the rate of acceleration is, however, of less importance than the action of the brakes on which the safety of the service depends. Both cars were fitted with a Westinghouse quick-acting brake, hand-brakes and an electric brake acting by reversing the currents through the motors. The "A" car had, in addition, an accumulator battery, the current from which could be sent through the three-phase motors. A great many trials with these brakes are reported which are not important enough for recording in detail, as the brakes were not satisfactory, but a few curves are reproduced in Fig. 1, showing the results. In Fig. 2 the decrease of speed is shown when the "A" car was left to itself after attaining a speed of about 106 kilometres per hour. The wind at the time was west-northwest and had a speed of 11.4 metres per second; it offered, therefore, less resistance during the run from Marienfelde to Rangsdorf than in the opposite direction.

Very numerous observations were made about the consumption of energy both in the generating station and on the cars, especially during the last set of runs. For this purpose readings were taken at the switchboard in the generating station every ten seconds of the volts, amperes and watts, and the periodicity of the current was checked by the number of revolutions of the generating set. On the cars amperes and volts were read at intervals of from fifteen to thirty seconds. The measurements at the station were the most accurate, as the instruments there were

not exposed to the vibrations unavoidable on the cars. After making the observations they had to be corrected, as the instruments were only correct at a certain periodicity. Numerous further measurements were taken, and the following table gives the average result of the power required at the constant speed:

Car.	Speed.	B. H. P.			Efficiency of Electrical Outfit.		Consumption of Steam.	
							Kg. per B.-H.-P. per Hour.	
	Km. per Hour.	Measured at Feeding Point.	Measured at Car Collector.	Calculated from Speed.	Car by Itself. Per Cent.	Car and Conductors. Per Cent.	At Car Wheels.	At Flywheel of Steam Engine.
"A"	118	478	455	397	87	83	5.84	4.6
"S"	115	431	405	341	84	79	6.12	

The report does not consider these figures reliable enough for commercial deductions, partly because the instruments were not properly calibrated for the varying periodicity of the current, and partly because the motors in both cars were working very much below their rated output.

For the purpose of observing the air resistance at the various speeds openings were made in various parts of the car bodies and short brass tubes inserted. These tubes were connected by india-rubber tubes to a row of pressure indicators consisting of pairs of communicating glass tubes about five millimetres in diameter partly filled with water. An adjustable scale was fitted to each indicator divided into millimetres, so that the difference in the water level of the two tubes could be observed at the various speeds. Four such openings were made at each end of either car, two of which were near the centre and the other two at the sides, as indicated in the diagrams of Figs. 3 and 4.

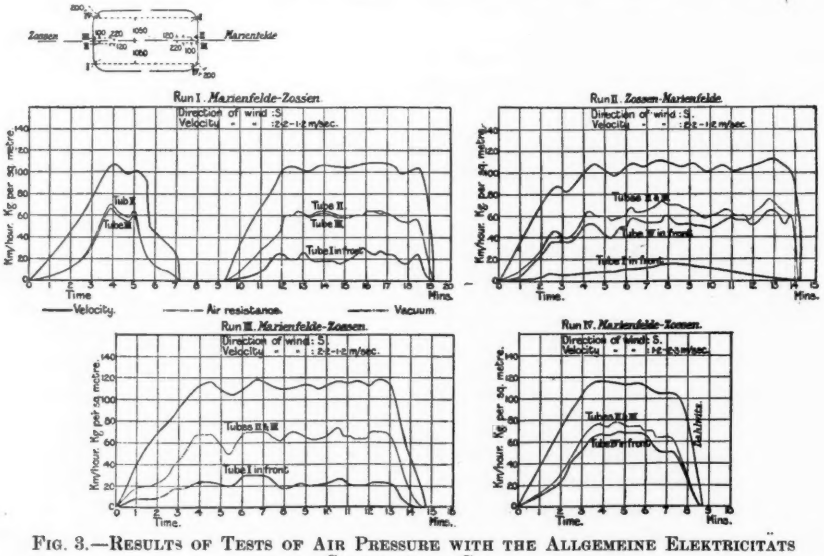


FIG. 3.—RESULTS OF TESTS OF AIR PRESSURE WITH THE ALLGEMEINE ELEKTRICITÄTS GESELLSCHAFT CAR.

Preliminary trials proved that the position and the form of the opening of the brass tubes have no influence on the result, and this made it possible to compare the pressure all over the front of the car with the pressure in the centre, independent of the varying speed of the car. In addition, straight tubes, up to 3.4 metres long, were fitted to explore the pressure of the air in front of the car, and these observations showed that a cone of uniform pressure exists in front and at the back of the car, the apex of which was about three metres distant from the car. The "A" car, as the diagram shows, has well-rounded corners, while the "S" car has its ends in the shape of truncated cones. The pressure on these was very much smaller than in the centre, and sometimes even negative owing to the influence of the wind. Some openings were also made along the sides of the car and occasional observations showed that speeds had very little influence on the pressure indicated, when the brass tubes ended flush with the sides of the car, and that the direction of the wind has much more effect. Figs. 3 and 4 show the results of

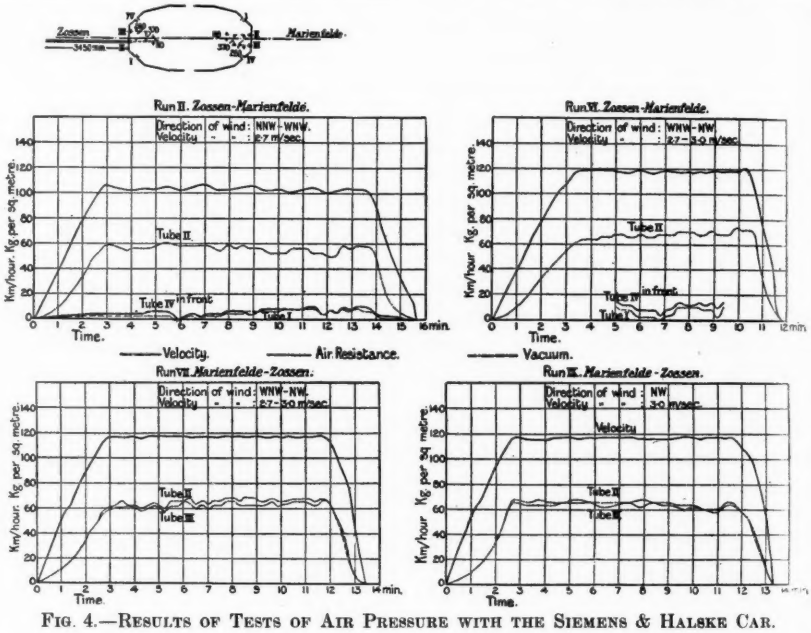


FIG. 4.—RESULTS OF TESTS OF AIR PRESSURE WITH THE SIEMENS & HALSKE CAR.

observations made during several runs on both cars. Combining all the results the report considers that up to a speed of 150 kilometres per hour the pressure may be calculated by the equation $p = 0.07\ v^2$, when v is the velocity in metres per second and p is the pressure on a surface of one square metre, at right angles to the direction of the motion. The number of observations were, however, insufficient to determine the best form for the end of the cars. Another set of observations was made to determine the extent of the movement of the rails, when the cars were passing at various speeds. For this purpose measuring apparatus were set up at various points of the lines, which are shown in Fig. 5. Each of these consists of three strong posts, about one and one-half metres long, rammed into the ground, one in the centre and one on each side of the rails, to which a strong board is fastened with its upper edge a little below rail level and with suitable openings cut

to permit the rails to pass through. Near each rail two short boards are bolted to the plank, between which a lead plate is supported. This is cut in two and fitted accurately against the rail, the edges touching the rail being sharpened. It is evident that any movement of the rail will bend these edges back and thus leave a permanent record of the greatest movement of the rail. The results on one set of lead plates is shown in Fig. 6, and a summary of the principal observations is the following:

Distance between Sleepers. Mm.	Material of Sleepers.	Ballast. Motor Cars.	Speed Km. per Hour.	Depression of Rails in Mm.
850	wood	sand	108	2.0—2.5
850	wood	sand	114	3.5—5 0
780	wood	stones	145	6.0—6.5
780	iron	sand	114	5.0—5.5
780	iron	sand	135	6.0—6.5
730	iron	sand	123	6.0—7.0
		Military trains.		
850	wood	sand	70–80	1.5—2.0
730	iron	sand	70–80	4.0—

From these experiences the conclusion was drawn that the permanent way had to be thoroughly reconstructed before speeds exceeding 120 kilometres per hour could be safely investigated. As the military trains ran only at considerable intervals, at a comparatively low speed, the existing signaling apparatus had to be supplemented by distant signals about two kilometres from the stations, and some difficulty was also experienced in seeing sufficiently far ahead in rainy weather. It is, therefore, suggested to repeat the signals on the car by visual and by audible means, which should also indicate when the apparatus is out of order. In addition it is recommended to cut the current off in the sections which a car has just left.

In conclusion, the first report states that, thanks to the care exercised by the firms supplying the cars and outfit, to the cautious and reliable execution of all the electrical work, to the careful maintenance of the permanent way and its appurtenances, and to the conscientious observation of all the precautionary measures, no mishap or damage of any kind has occurred during the trials. No psychological effects on the drivers or passengers, attributable to the high speeds, have been noticed. Although it has not been possible to obtain reliable data for judging the economical aspect of this question, some valuable technical information has been gained. In the first place, the experiments have shown that it is possible to collect high-tension currents even in unfavorable weather from overhead conductors at double the speed of the present express trains. Both the conductors and the collectors have worked so satisfactorily up to the present that their efficiency at higher speeds may be safely assumed. Three-phase motors have shown themselves reliable, and their overheating has been prevented by suitable ventilation. It has, however, not been possible to decide whether it is preferable to fix the motor on the axle or support it wholly by springs; nor can it be safely said whether fluid or metallic resistances are the more suitable. The brakes have not been powerful enough for the high speeds. An alteration of the existing arrangements and the adoption of an efficient electric brake appears to be imperative. Generally speaking, the first year's trials have served principally to find out the best methods of making observations and to determine

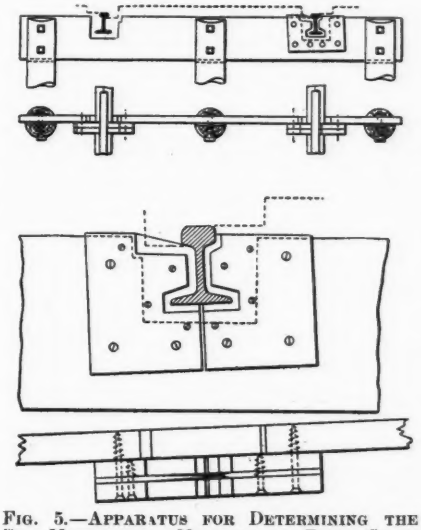


FIG. 5.—APPARATUS FOR DETERMINING THE RAIL MOVEMENT ON MARIENFELDE-ZOSSEN LINE.

which are the most suitable instruments for obtaining trustworthy information. Basing further experiments on the knowledge thus gained, it is certain that it can be ascertained whether the cars, their equipment and all other outfit are suitable for regular traffic on main lines at a speed of 160 kilometres per hour, and whether still higher speeds are practicable, especially from an economic standpoint. Originally it had been the intention to resume the experiments in 1902 on the lines laid down at the commencement, and to increase gradually the speed of the cars until a speed of 200 kilometres per hour had been attained. It was, however, not possible to relay the permanent way in time, and in consequence of this the authorities would not allow a greater speed than 125 kilometres per hour. The time was, therefore, utilized for determining more accurately the resistance of the cars

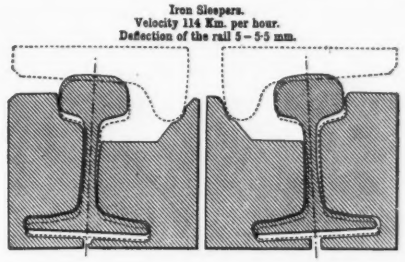


FIG. 6.—LEAD PLATES, SHOWING RAIL MOVEMENT ON MARIENFELDE-ZOSSEN LINE.

at various speeds, the power required for propelling them and the losses of energy in the feeder and the conductors. In addition to this, further experiments were made with the brakes, and alterations in the structure of the cars were considered, to ensure steady running at high speeds; the movement of the rails was also observed during the trials.

(To be continued.)

Transactions of the American Electrochemical Society.

Volume v of the transactions of the American Electrochemical Society is being distributed. This contains the papers and discussions of the fifth general meeting, held in Washington, D. C., April 7, 8 and 9, of this year. Among the articles of particular interest may be mentioned the presidential address, by Dr. Joseph W. Richards, on "The Continuous Advance of Electrochemistry"; a paper by Dr. Henry S. Carhart and Mr. George J. Hulett, on "Preparation of Materials for Standard Cells, and Their Construction," and "A Contribution to the Study of the Electric Arc," by Dr. William S. Weedon. There are also interesting papers by Mr. C. I. Zimmerman, on "The Aluminum Electrolytic Condenser"; by Messrs. C. F. Burgess and Carl Hambuechen, on "Electrolytic Iron"; "Electric Smelting Furnace Experiments for the Manufacture of Ferro-Nickel from Pyrrhotite," by Mr. Ernst A. Sjöstedt, and "The Economic Balance in Electrolytic Copper Refining," by Mr. Lawrence Addicks. The frontispiece of this volume is an excellent portrait of Dr. Henry S. Carhart, the new president of the society. The volume gives also a directory of the members, brought down to May 7, 1904.

Electrical Notes from Europe.

By Our Special Correspondent.

THE Issy generating station, one of the large Paris plants, is shortly to install four alternators of 600 kilowatts capacity. These are to replace the machines which have been in use up to the present, as these have now become insufficient owing to the increase in the plant, and besides it was desired to install apparatus of a more modern type. The alternators are to be operated by horizontal steam engines of 600 horsepower. They will be provided with a heavy flywheel of eight tons. These machines are of the Westinghouse type and work at 3,000 volts and forty-two cycles. Each of the units will have an exciter of twenty-five kilowatts, giving 125 volts. The exciters are to be operated from the main engine shafts by means of gearing. It is expected to equip the plant with a total of ten alternators, of which five will be of the Westinghouse pattern.

The telephone system in Paris has long been a cause of dissatisfaction to subscribers, and it is claimed that in no large city of Europe is the telephone so badly managed as here. This is due to different causes, one lying in the inefficient administration (the system is operated by the government) and another in the old types of apparatus which are used. It is stated that if Paris had the modern apparatus which is used in America, for instance, half the trouble would be avoided. The operators are overworked, and there is a great lack of discipline in the central stations. The subscribers are at a disadvantage owing to the monopoly which exists, and up to the present their protests have had but little effect. The matter has been brought to a head lately owing to some difficulties which occurred between certain subscribers and the administration, resulting in several law suits. The subscribers have now formed an association in order to defend their interests and it is hoped that this action will lead to some reforms.

According to recent accounts, an artificial substitute for gutta-percha has been discovered in Germany by Adolf Gentsch. This product does not soften even at very high temperatures. It has a higher insulation resistance and a lower dielectric constant than gutta-percha. The new product is a mixture of Para rubber and a kind of palm wax. The melting point of the wax is so near that of the rubber that it is almost impossible to separate them by melting. Cables have been constructed with the new product by a large German firm and these have been tested in the laboratory of the telegraph administration at Berlin. The results proved so satisfactory that it was decided to make a series of tests on a larger scale. For this purpose the manufacturers constructed about fifteen miles of cable covered with the new product. One of these cables, which contains four wires, has been in operation for some time past between an island and the mainland, and up to the present time has stood the tests very well. The company guarantees an insulation resistance for the new cables of 500 megohms and a capacity of 0.15 microfarad per kilowatt. Another advantage of the new product is that it is thirty-five per cent cheaper than ordinary rubber.

Some figures have been recently published relating to electric tramways in France. At last accounts there were 3,360 miles of lines in operation. The lines are controlled by 172 different companies. The outlay of capital for the construction of these roads represents $161,000,000. The electric tramways of the city of Paris and department of the Seine figure for 225 miles in the total. Of this amount there are 115 miles of road which follow a common traject. These lines are controlled by ten companies and represent a capital of $47,200,000 expended in installing them. The total receipts from these lines during the first half of 1903 are $4,600,000.

An electric traction line of considerable interest is now running between the city of Dresden and the suburbs, using accumulator cars. Trains are made up of two motor cars connected together. Each car contains two motors of thirty horsepower, which are coupled in series. The motors are of the four-pole type and drive the car axle by a single reduction gearing whose ratio is 1 to 2.2. The cars are nineteen metres long and weigh forty-five tons. They have a capacity of 100 passengers each. One feature of the new cars is an improved system of electric brakes, which are worked by solenoids and operate sixteen brake-shoes per car. The battery which is used here is made up of 184 double cells, which have a capacity of 425 ampere-hours at a discharge rate of 150 amperes. This battery is formed of ebonite cells, which are placed in wood boxes. The latter are disposed under the seats which run along the length of the car. To charge the battery at the stations, all the cells are thrown in series by a special switch or by making another connection they can be charged at a lower voltage. The battery furnishes a voltage of 370 to the two motors in series. The new system has been in operation for several months, and up to the present has proved very satisfactory.

The new branch of the Paris Metropolitan which encircles the southern district of the city is now nearly completed as far as the tunnel and the overhead structure are concerned. The overhead part figures for about two miles in a total of eight miles for the whole section. The remainder lies in subway. The overhead portion was needed on account of the great irregularity in the ground. The elevated structure is now practically finished and is ready to receive the tracks. One of the new bridges which is to take the line over the Seine is now in construction. It consists of a lower metallic structure which serves as an ordinary bridge and this will uphold the Metropolitan upon iron columns. The total length of the new bridge with its approaches will be about 1,300 feet. Some of the underground stations in the new line are of considerable size, in order to provide for the junction of some of the other lines which are to be built later. A second bridge is to be constructed where the line crosses the Seine again in the eastern part of the city. When the new section is completed it will form a complete circular line around the city in connection with the northern section, which is already running. This circular line will be cut across in the middle by the old section of the Metropolitan which runs east and west, and thus by means of transfers passengers will have a ready access to different points of the city.

A new form of telephone transmitter which is claimed to be greatly superior to others has been invented by a Brussels engineer, M. Sheers. It reproduces the voice, music, etc., with much greater clearness than the existing forms. The transmitter is formed of granulated or powdered carbon, which is contained in a kind of pocket or bag of leather or other flexible substance. The pocket is suspended in front of the diaphragm of the tele-

phone. The latter is provided with a blunt projection of ivory which touches the pocket and thus transmits the vibrations. Current is brought to the granules by two small plates of carbon which are placed opposite each other inside the pocket. The grains of carbon can thus take the required position by their own weight. One advantage of the system is that it prevents the grains from being two strongly compressed and a good equalization is obtained between the plates. Another point is the absence of contact with the metallic vibrating parts of the transmitter. The new instrument has two discs with a space between them and the pocket is suspended in the inner space. The discs are made of pine wood and are very thin and light. They are braced across by a strip of wood. This form of transmitter is claimed to be cheaper than most others, and is said to be superior to all existing forms as to sensitiveness and reproduction of sounds.

A great number of investigations are now being made upon the question of the N-rays and many interesting facts have been brought out lately by different experimenters. One of the most recent discoveries in this line is the fact that induced N-rays can be obtained by exposure of certain bodies to the action of the rays. This was first noted by M. Blondlot, who found that some bodies when submitted to the action of N-rays seemed to store them up and emit them again for a long time. Following out this idea, M. Bichat made some recent observations, and finds that the character of the induced rays is not the same as that of the original radiation. He exposes a plate of copper for one minute to the N-rays coming from a Nernst lamp. If the plate is then observed by means of a phosphorescent screen, it is found to give off N-rays on the exposed side, which will traverse an aluminum screen. The unexposed side does not produce them. The action lasts for a long time after the exposure. He studies the character of the secondary rays and finds that the N-rays are transformed to a radiation which has a higher index of refraction. Copper, zinc and glass will produce the secondary rays when exposed to N-rays. On the contrary, platinum, silver and aluminum have no action under the same circumstances.

St. Petersburg will soon have a series of public telephone stations, if the present project which the municipality is considering is to be carried out. The system will be started by installing a number of public telephone cabins in the principal localities of the city, such as the railroad stations, large hotels and restaurants, public gardens, etc. It is proposed to commence with forty such stations and a part of them will be provided with automatic coin-operated apparatus. The public will thus be able to communicate within the city or to the suburbs and also make use of the long-distance line which now runs from St. Petersburg to Moscow.

There is some talk of constructing an electric railroad of considerable importance between Turin and Martigny, a town in Switzerland. The total length of the line will be 105 miles. It is proposed to obtain current for the railroad from a number of waterfalls which are situated in the neighborhood. This line would be of considerable service to the district it passes through, seeing that the country is rich in ores of different metals, but these can not be worked at present, owing to lack of transportation facilities. The new project has been drawn up by Mr. Radcliff Ward, a prominent engineer. It is to be presented to the Italian minister of public works in the hope of obtaining a concession for the new road.

One of the latest Russian projects is the use of water power which is to be obtained in the neighborhood of St. Petersburg for operating an electric tramway system in the city. A commission which was appointed to examine the question recently made its report and considers that the falls which are best adapted for the purpose are those of the Vonoska region, which lie at ninety miles from St. Petersburg. As to the relative cost of energy from different kinds of motive power, the price per kilowatt-hour for steam would be $0.0151, for gas motors $0.0103, while water power, supposing a loss of twenty-two per cent, figures for $0.0098. According to calculations, the expenses of installing the hydraulic plant would be about $8,000,000. Another Russian project is that of an electric railroad in the Baltic region. It is proposed to use the electric system on the Oranienbaum line, which is one of the leading railroads in the district. At present the trains are made up of sixteen cars. With electric cars a three or four-car train would be used, with three-minute intervals between the trains.

At present a number of projects are being discussed for utilizing the energy of the Victoria falls on the Zambezi river. This matter has been brought up owing to the fact that the new African railroad, which is to connect the Cape with Egypt, will pass near the falls. The railroad is expected to reach the falls next year. A large amount of power can be obtained here, as the falls are over 350 feet high. The Anglo-African syndicate is investigating the matter and will make an estimate on the spot as to the amount of power which can be obtained, as well as the expense of installing the plant. The power could be used to great advantage in the gold and copper mines of Rhodesia, which are situated not far from this region. The railroad could, no doubt, profit by such a large source of power in the vicinity.

The use of hydraulic power in Spain is on the increase, and a number of plants are now in successful operation. Among these may be mentioned a large carbide works, which is located in the north of Spain not far from Barcelona. Two other large carbide plants using water power, those of Berga and Espanaguera, are now running with increased capacity. Among the newly installed hydraulic plants is that of San Quirico, recently erected, also another at Camdemola. A 3,750-horsepower plant is now being constructed at Vich and a project is being considered for building a station at the falls of the Serge, using a high-tension transmission line to a distance of 100-150 miles. As to electric traction, one of the newest roads is the Barcelona-Ripoli system, which is to be extended to the northern frontier, where it will join on to the French line which is to cross the Pyrenees.

C. L. DURAND.

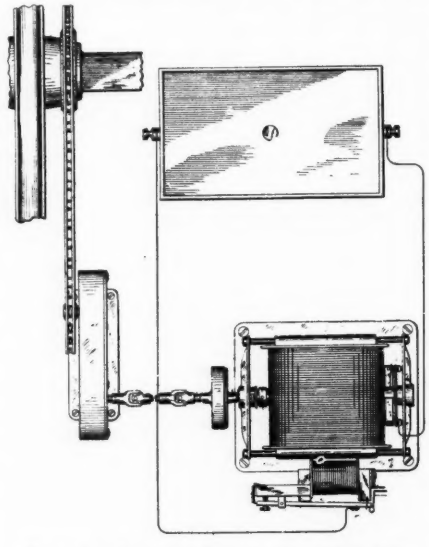
Paris, June 2.

New Radium Finds.

United States Consul-General Richard Guenther, at Frankfort, Germany, reports that hardly a day passes without news of new finds of radium in some country. It is said to exist in the layers of Oxford clay in southern England, and while particulars are not given, the report ventures the hope that these clay deposits in the near future will become more valuable than gold mines. The chemist Laudin, of Sweden, has discovered a large deposit rich in uranium, and has already extracted radium from this. The location of the deposit is not made known. In the mining districts of Portugal uranium has been found to exist, and it is thought that the Portuguese government may be inclined to establish a radium industry. A commission of experts has been appointed to investigate this matter.

Electrical Patents.

An electric lighting system for vehicles has been devised and patented by John A. Little, of St. Louis, Mo., and the patent assigned to the Globe Electric Company, of the same place. In the embodiment of the invention a gear-wheel is fastened upon the hub of a vehicle wheel, and a gear-casing is fastened upon the bottom of the vehicle. This gear-casing has a gear-wheel journaled in it, a chain connecting this last gear-wheel to the first mentioned gear-wheel. The gear-casing contains suitable gear for driving the casing at a high rate of speed from the rotation of the hub. The shaft carries one member of a universal joint, the other member of which is fastened to a shaft, which carries upon it an annular member forming part of the friction-clutch. The opening in the annular member is closed by an annular flange, carried by a hub. Segmental members are pivoted at their lower ends to the inner side of the flange. Pivoted at the upper ends of these members are links, pivoted at their lower ends to one end of a bent lever which, in turn, is pivoted to the inner face of the flange and carries at its lower end a weight. The spring, fastened to the lever and to the inner face of the flange, serves to hold the parts when stationary so that the outer surface of the segmental members is in contact with the inner surface of the annular member. The hub is secured to the armature shaft of a dynamo suitably fastened by means of a frame to the bottom of the vehicle. This dynamo is provided with two commutators, one at each end, and carries at one side an electromagnet, forming part of an interrupter. This magnet is provided with pole-pieces, one of which carries a support, to which is pivoted the armature of the magnet. A thumb-screw serves to regulate the position of the armature and a spring is provided to hold the armature normally away from the pole-pieces. One of the pole-pieces is also provided with a contact and a similar contact is carried by the end of the armature. Conductors connect the dynamo with a storage battery. The electrical connections of the dynamo with the battery and lights are as follows: the armature of the dynamo is provided with two windings, one winding being connected through a commutator with a wire leading to the battery, and at its other end through the interrupter with a wire also leading to the battery. The other winding of the armature is connected at one end with the electromagnet and at the other end through the commutator by means of the wire with the field. The opposite end of the electromagnet is connected by means of a wire with the remaining end of the field winding. Thus the field winding and the electromagnet are connected in series with the armature winding. Incandescent lamps are connected by means of wires with the conductors. A switch is also provided for making and breaking the circuit from the armature winding through the lamps. The battery is permanently connected at one end with one conductor wire and at the other is adapted to be connected to the other conductor by means of a switch. Another switch is adapted to connect the battery through the wires with the lamp. In the operation of the invention, the rotation of the hub causes the member of



ELECTRIC LIGHTING SYSTEM FOR VEHICLES.

the friction clutch to rotate also. The members pivoted to the flange, being in contact at starting with the inner surface of the member and the armature shaft, to which the flange is fastened, will also be rotated, and current will thus be generated in the armature windings. As soon as the current in the armature winding becomes sufficiently strong, the armature of the interrupter will be drawn down by the current flowing in the coil, which is connected with one of the armature windings, so that the respective contacts of the pole-pieces and armature will meet, thus closing the circuit through the battery or the lamps or both the battery and the lamps at the same time. It is evident that when the rotation of the friction clutch reaches a certain limit, the centrifugal force thereby generated will swing the weight outward on the pivot, thus withdrawing the segmental members from contact with the annular members and serving to keep the rotation of the armature constant at the requisite speed, but not allowing it to exceed such speed. When the switches are open, the battery will be out of circuit and the lamps will be fed with current from the armature winding, so that when the vehicle is moving the battery will furnish no current to the lamps. If, now, one switch is closed, the battery will be connected in the circuit in multiple with the lamps and the surplus current not used for the lamps will be employed to charge the battery. If, now, one switch is opened and the other closed, the third switch being also open, the battery will be employed to supply current to the lamps, thus enabling the lamps to be kept lighted when the vehicle is stationary and the dynamo not in operation. When the vehicle stops, the cessation of current in the armature winding will allow the spring to draw back the magnet armature, thus breaking the circuit from the dynamo winding through the lamps. In practice, the parts of this system are so proportioned that the circuits through the lamp and the battery will not be completed by the automatic interrupter until the voltage of the dynamo winding supplying current to the lamps and battery exceeds the voltage of the battery. When the vehicle is stopped and the voltage of the armature windings supplying the lamps and battery falls to approximately the voltage of the battery, the circuit is again broken by the automatic interrupter, thus preventing the battery from discharging back through the armature winding in case it should be connected in the circuit when the voltage of the armature winding is below the voltage of the battery.

The American Telephone and Telegraph Company, a corporation of New York, is the assignee of a patent recently granted to Mr. Joseph J. O'Connell, of Chicago, Ill., on an improvement in earth or grounding-wire attachments. Grounding-wire connections are commonly wound around a metal gas or water pipe, and to make good electrical connections are preferably soldered thereto. It is not always convenient to solder it, however, and the purpose of the present invention is to provide effectual means for securing the grounding-wire to a gas or water pipe, and also for keeping the convolutions of the wire in a taut condition, so that they will be in constant contact with the pipe and with each other, and so provide a path of low resistance for any current for which it is intended. In carrying out the invention, a wire-straining device is employed, used in combination with the

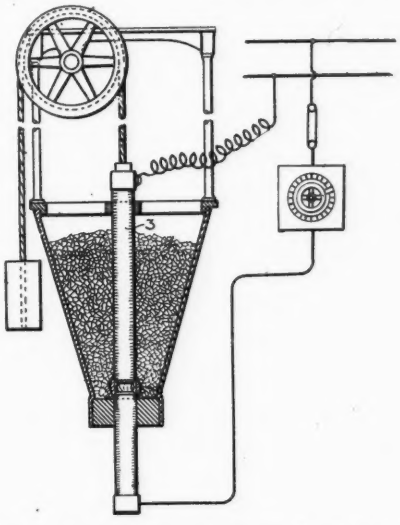
grounding-wire and the gas or water pipe. It consists of three parts: first, a saddle-piece, which is placed across the gas or water pipe; second, a spring-straining nut, extending through the saddle-piece and provided at each end with spring loops over which the grounding-wire is wound, and third, an adjusting screw, which extends through the arch of the saddle-piece and is threaded into the nut. When a grounding-wire is to be applied to a pipe, the pipe is carefully scraped or filed and the saddle-piece is placed across the pipe with the nut extending parallel to it and resting upon the surface of the pipe, the screw being withdrawn to permit this to take place. The wire is then wound about the pipe and over the loop terminals of the nut, giving at least ten turns over each loop, and the loose end of the wire is twisted back on to the main part which is connected to a binding-post, from which a lead is made to the line circuit or to the apparatus. In order to bring the wire into intimate contact with the surface of the pipe, the screw is turned, causing the nut to move away from the pipe, and thereby straining the wire, and as the loops of the nut are resilient, they are bent downward by the pull of the wire convolutions, thus producing a resilient stress upon them, so that ordinary heat and cold will not cause them to slack off or loosen on the pipe.

A fan motor has been invented by Mr. Augustine R. Everest, of Lynn, Mass., having for its object the provision of a fan motor in which the air will be distributed over a wider angle than with fans as commonly constructed. The patent obtained on this invention has been assigned to the General Electric Company, of New York. A pedestal is em-

FAN MOTOR.

ployed and a vertical shaft upon which is mounted the casing of the motor for operating the fan. In the direction of blast delivered by the fan is mounted a curved deflector, having its concave surface below and opposite the fan blades, serving to divert the column of air impinging upon it in a substantially horizontal direction from all parts of the periphery. This angle may be varied by rendering the deflector and fan relatively adjustable. In one embodiment of the invention, the fan is made adjustable and is mounted on a sleeve which may be set at different heights on the shaft by means of a screw. A protecting cage of stiff wire may be placed over the parts. By moving the fan to different positions along the shaft the angle of blast is altered and may be varied from a radial distribution to a distribution in the form of a hollow cone.

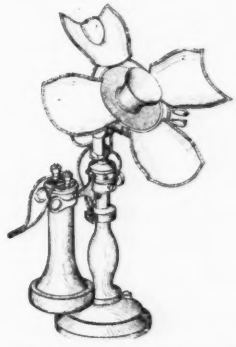
Mr. Elihu Thomson, of Swampscott, Mass., is the inventor of an improvement in the production of tubes from refractory material, which he has assigned to the General Electric Company, of New York. A hopper is employed in which



APPARATUS FOR PRODUCTION OF TUBES FROM REFRACTORY MATERIAL.

is placed a mass of granular quartz free from any large percentage of impurities. The lower end of the hopper is provided with an electrode, the inner end of which is located at or near the level of the bottom of the hopper. A cooperating electrode formed of carbon and of a diameter which is made great or small in accordance with the desired interior diameter of the tube to be formed, is mounted within the hopper, so that it may be brought into contact with the lower electrode. The electric connections of the electrodes are made so that current of regulable value may be supplied thereto. The source of supply is indicated by supply mains from which extend leads, connected, respectively, to the electrodes, and in one of which is inserted a resistance box or other suitable current-regulating means. The difference of potential source should be such as to permit the maintenance of a long arc upon the separation of the electrodes. Upon the establishment of a circuit through the electrodes and the gradual separation of the electrodes, as by slowly lowering a weight, serving as a counterbalance for the electrode and put into motion by the slow revolution of the wheel, over which passes a flexible connection between the weight and the electrode, an arc of gradually increasing length is drawn between the electrodes. The granules of fused quartz fuse so as to produce a small ring, which is gradually built up by the addition of adhering layers of fused quartz until a complete tube is formed. This tube is then mounted upon a carbon rod and inserted in the flame of an arc and turned until its exterior has been progressively exposed to the heat of the arc, thereby producing a fusion and compacting of the exterior surface of the tube, such as to render it smooth.

A patent has recently been obtained by Mr. Robert D. Fannon, of Chicago, Ill., on a telephone transmitter hood, the object of which is to provide an apparatus by which a desk telephone can be used without any one in the vicinity being able to hear the message transmitted. The patent has been assigned to Delos Dunton, of Carpentersville, Ill. In carrying out the invention, a split-clamping ring is employed, which is adapted to be clamped upon the transmitter, preferably with a rubber band or ring interposed. Secured upon this ring is a casing, preferably made of light sheet metal. The edges of the opening are covered with rubber, and the



TELEPHONE TRANSMITTER HOOD.

opening is so shaped as to receive the mouth of the user. A depression is formed in the upper sides of the casing to accommodate the nose. The edges project forward to meet the cheek and at the bottom to extend beneath the chin. The hood or casing is so located and the aperture so shaped as to bring the lips to the proper distance from the mouthpiece and to prevent the sound of the voice escaping from the hood. The hood is split into four wings, each of which is pivoted to the front edge of its ring. Staples are secured to the back of each wing near its pivot and a spring-ring is passed through the staples and formed with outwardly turned ends, so that by pulling the ends together the diameter of the ring is increased, so that they can be folded together to form the hood ready for use.

Reviews of Current Engineering and Scientific Literature.

Influence of Light on the Rapidity of Formation of Accumulator Plates.

In this article M. Georges Rosset discusses the announcement made recently by M. D. Tommasi, that light affects the rapidity of formation of accumulator plates. M. Tommasi stated two laws, the first being that negative plates are formed more rapidly in the light than in the dark, and, to the contrary, positive plates are formed more rapidly in the dark than in the light. It seems to the author that this is only two statements of one law, which he restates as follows: darkness favors the oxidation of lead, and, as a consequence, light favors the reduction of lead oxide. This is a general law, which is a direct consequence of the phenomena of chemical equilibrium. It is an application of the universal principle of action and reaction, and corresponds to the effect of temperature in assisting endothermic reactions. Light, being a positive manifestation of energy, tends to unbalance equilibrium in the endothermic sense—that is to say, it favors the reduction of salts of which the formation is exothermic.—*Translated and abstracted from L'Eclairage Electrique (Paris), June* 18.

Atmospheric Radioactivity.

Recent investigations have shown that radioactive gas may be obtained from water and from petroleum, this gas having the same properties as the emanation from radium. These facts suggested to Dr. H. A. Bumstead that some of this emanation must be present in the air above ground, and that the radioactive phenomena of the atmosphere might be due to its presence. An investigation has been carried out to determine whether such were the case. A long wire was stretched between two buildings and connected to the negative pole of a Wimshurst machine driven by a small motor. The other terminal of the machine was connected to the earth, and a parallel spark-gap kept the potential difference between the two constant. After allowing the wire to remain in this position for some time it was coiled up on a frame and placed within a cylindrical testing vessel, and the effect upon an electrometer noted. Curves were traced, showing the decay of the radioactive property of this wire, these curves showing a decided resemblance to radium emanation during the first two hours. When, however, the experiments were extended over a longer time, it was found that the rate of decay changed, becoming much slower than for radium. A possible explanation of this is that the radioactivity of the air is due to a combination of radium and thorium. The possibility of the presence of actinium was investigated and found to be improbable. The conclusion is reached that the radioactivity acquired by a negatively charged wire exposed to the open air is mainly, if not wholly, due to the excited activities of the radium and thorium. With a three-hour exposure three to five per cent of the total initial effect is due to the thorium activity. With a twelve-hour exposure the thorium activity is sometimes fifteen per cent of the whole. There is some evidence that a small quantity of a more rapidly decaying activity is present in addition. It is thought that the radioactivity of rain and snow is due to radium-excited activity, the absence of the thorium effect being accounted for by the fact that the rapid decay of the thorium emanation prevents its reaching, in appreciable quantities, the height at which the rain drops are formed.—*Abstracted from the American Journal of Science (New Haven), July.*

Organization and Work of the Bureau of Standards.

A complete description is here given by Dr. Edward B. Rosa, the physicist of the Bureau of Standards, of the work and organization of that department. The plan of organization is given in detail, and a brief sketch of the history and development. At present, due to lack of equipment and assistants, the work is necessarily limited, the aim being to prepare the bureau for efficient work in the future. In that division, which is of particular interest to electrical engineering, a considerable part of the work consists of the verification of apparatus for the measurement of resistance and electromotive force for the other sections of the bureau. A number of special instruments have been designed and constructed for this section. Preparations are now under way for magnetic testing. A careful study of mica and paper condensers has been made, and a number of standards of inductance have been secured and their values determined. The bureau is now in a position to make accurate measurements of both capacity and inductance, and to compare capacity and inductance standards for the public. The bureau is also prepared to test alternating-current voltmeters, ammeters, dynamometers, wattmeters, watt-hour meters, phase and power-factor meters, frequency indicators and other similar apparatus. Some tests were made recently on a lot of watt-hour meters, with a view to studying the effects of such conditions as a variation in wave-form and the power-factor from the normal. The bureau can handle apparatus of capacities up to 1,000 amperes and 1,000 volts, and a storage battery is being installed which will give currents up to 10,000 amperes, and another giving potentials up to 7,000 volts. In photometry considerable preliminary work has been done, so that the bureau is now prepared to test and certify incandescent lamps as standards. Much work has been done with the Hefner amyl acetate lamp. It was found that this was not satisfactory for frequent testing. For this reason a set of reference standards and another set of working standards consisting of incandescent lamps have been prepared. The purpose of the bureau is not to undertake commercial testing of incandescent lamps, but is only to verify lamps to be used as standards, and to make special investigations of lamps submitted for the purpose. The bureau has also undertaken to operate a test laboratory in the Electricity Building at the World's Fair, St. Louis. The work here will include the verification of measuring instruments to be used by the jury of awards in testing electrical machinery, and the testing by the jury of awards of instruments and apparatus submitted by exhibitors in competition.—*Abstracted from Science (New York), June* 24.

Rubber-Planting in Ceylon and the Malay Straits.

Mr. Henry C. Pearson, editor of the *India Rubber World,* has been visiting the rubber-producing countries and looking into the resources of this material. He here gives an interesting description of the conditions in Ceylon and the Malay straits, where he visited a number of rubber plantations. On some of these the trees are planted through the tea plantations, the variety being the *Hevea,* which flourishes there. It, however, needs drainage, and does not do so well in low, swampy ground. The tapping of the trees is carried out early in the morning, as the *latex* does not flow readily through

the middle of the day. The trees are tapped when they show a girth of two feet, without regard to their age. On one of the plantations visited there are trees eighteen years old which have produced three pounds of rubber a year. They are now experimenting with the effect of scraping the bark of these trees, as this treatment seems to stimulate the lactiferous ducts. It is thought that in this way the older trees will yield about six pounds a year. There are only a few of the old trees, most of the others being seven or eight years of age. The rubber is cured by pouring it into shallow enameled pans, each pan holding about a quart. These pans are then placed in the curing-house and allowed to stand over night. Sometimes a drop or two of acetic acid is added to assist in the coagulation. In the morning each pan contains a pure white cake of soft, spongy rubber full of water. These cakes are rolled out on a zinc-covered table, and much of the water thus expressed. They are then dried in charcoal ovens, and afterward are air-dried for about a month. On one plantation a careful record is kept of each tree. The first year that the trees on this plantation were tapped, 4,600 pounds of first quality rubber were secured from 4,010 trees. The next year 10,500 pounds were secured from 8,300 trees. The owner of this plantation has a second, upon which 2,500 trees are yielding 3,500 pounds of rubber. Para rubber from Ceylon sells at Liverpool for about $1.20 a pound. Although, at the present time, there is a constant demand for *Hevea* seeds, the planters are looking forward to the time when they will have to be put to other use than planting. They are now experimenting with an oil made from the seeds, while the pressed cake makes an excellent food for cattle.—*Abstracted from the India Rubber World (New York), July.*

New Methods of Determining the Slip of Induction Motors.

Several methods of determining the slip of induction motors which have been tried with more or less success by Signor Ettore Bellini are here described. The first two are not new, at least in this country. One of them, credited to Seibt, is applicable to induction motors having a definitely wound rotor and slip rings. It consists merely in connecting an ammeter in one of the circuits, or attaching a millivoltmeter between two of the rings. The beats of this instrument will correspond to the number of revolutions of slip of the rotor. The second method, credited to Samojloff, is stroboscopic. A disc having alternate black and white sectors equal in number to twice the number of poles of the motor is employed. This disc is fixed on the axis of the motor, and is lighted with a lamp attached to the same circuit as the motor. If the room be darkened, the disc will appear to revolve in a direction opposite to that of the motor, the number of these revolutions indicating the number of revolutions of slip. In the first method suggested by Bellini, a disc or board is attached to a motor shaft. In this, slots equal in number to the number of pairs of poles are cut equidistant around the circumference. Back of this disc an incandescent lamp is placed, which is lighted from the circuit supplying the motor, the plane of the lamp filament being parallel to the disc. Besides this lamp a permanent magnet is fixed. This will set the filament into vibration, and if the filament be watched through the slots in the disc, it will appear to oscillate slowly in time with the slip of the motor. If m is the number of vibrations of the filament counted in this way, n the frequency, and t the time, the slip will be equal to m divided by $n\ t$. In Bellini's second method the permanent magnet is removed and the lamp is viewed as before through the slots of the disc. The intensity of illumination will appear to vary slowly, the number of such variations indicating the slip of the motor. The latter two methods are more satisfactory if the lamp is burned at about half the normal voltage. The first of them is said to be the more satisfactory.—*Translated and abstracted from L'Electricien (Paris), June 18.*

A Direct-Current Generating System Giving a Practically Constant Voltage at a Variable Speed.

A condition sometimes confronting the engineer is one in which a constant potential must be obtained from a dynamo which is driven at a varying speed. One method of solving this problem is here described by M. F. Loppé. Considering first the theoretical conditions to be approximated, it is found that the product of the exciting current and the speed of the generator must be constant, if the voltage is to be constant, assuming here an intensity of field excitation which is proportional to the exciting current, a condition which is necessary for the success of this system. This relation just stated is represented by a curve which is one branch of an equilateral hyperbola. As the first approximation for this characteristic, let the dynamo be excited from a source of constant potential such as a storage battery, and connect in series in the exciting circuit a small generator coupled mechanically to the main generator, and arranged so that the electromotive force set up in the former is in opposition to that of the battery. This arrangement will give a characteristic of the generator which is a straight line if the excitation of the auxiliary dynamo remains constant, and the desired regulation is thus obtained approximately. To correct for changes in the voltage of the batteries, the auxiliary dynamo may be excited in several ways, either by connecting the fields directly across the battery, by connecting them in series with the charging current, or by a combination of the two methods. The second method, or the series connection, gives a very sensitive regulation, since the intensity of the charging current varies more rapidly than the voltage at the terminals of the battery. The method of applying this system to train lighting is then described. A certain amount of regulation is obtained by shunting with a resistance the field of the auxiliary dynamo. The usual complement of automatic switches is required, and an automatic device for closing the circuit when the speed of the car reaches a certain minimum. A device suggested for this is an adaptation of the common centrifugal governor. The system is also suitable for use with hydraulic motors where the head of water varies, and for windmills.—*Translated and abstracted from L'Industrie Electrique (Paris), June 25.*

Magnetic Disturbances.

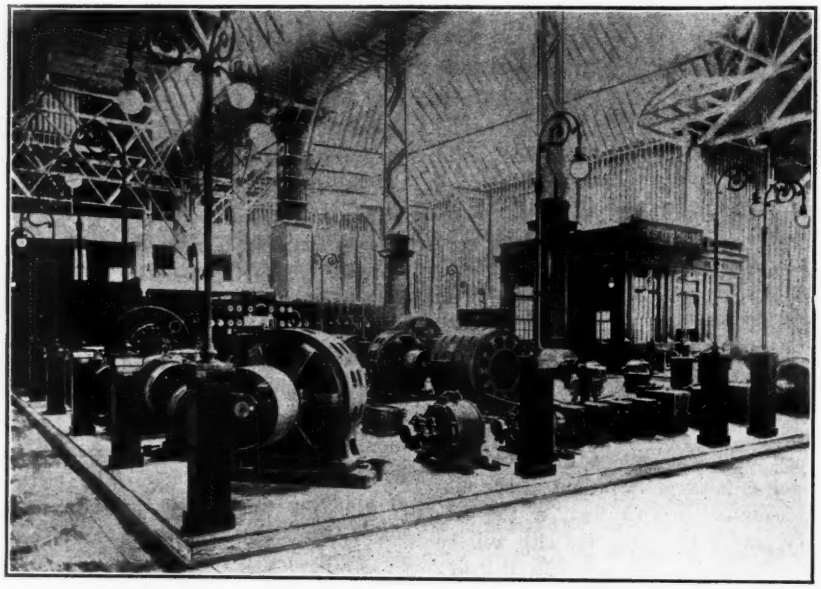
It is reported in *Terrestrial Magnetism and Atmospheric Electricity* (Baltimore) for June, that on May 8, at about twelve minutes after 10 o'clock, Greenwich time, a magnetic disturbance occurred at Cheltenham, Md., resembling in some respects of the one two years ago, which began with the eruption of Mont Pelée. It was reported in the daily papers that another eruption occurred on that day, but no definite information as to the precise time has as yet been obtained. On May 11 and 14, and again on May 26 and 29, there were notable disturbances, in both cases the total range in magnetic declination being about twenty-four minutes.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

The Westinghouse Companies at the World's Fair.

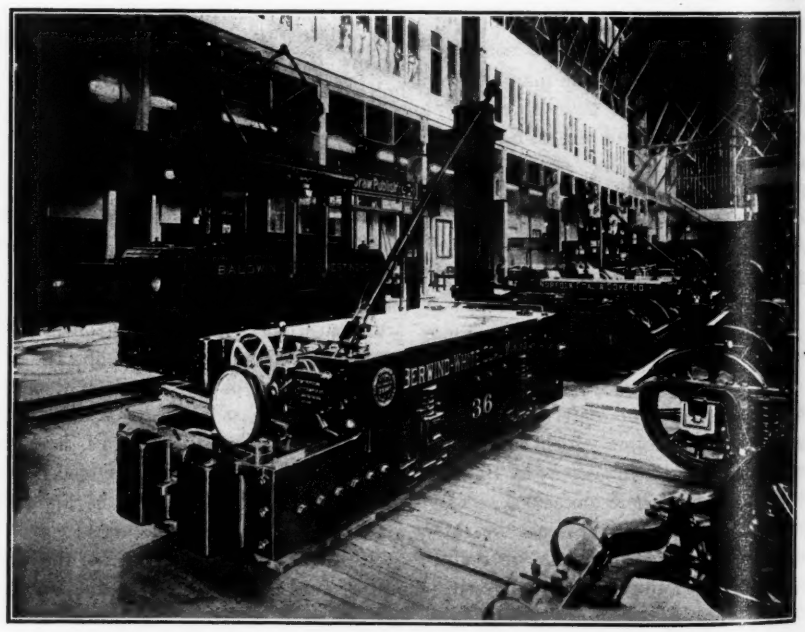
The main service plant at the Louisiana Purchase Exposition, for which the Westinghouse Electric and Manufacturing Company received the general contract, is naturally a notable feature of the Westinghouse exhibits, and one which appeals, because of the commanding size of the four big electric generating units, each of 2,000-kilowatt capacity and their location in the central aisle of Machinery Hall, to practically all visitors to the fair. Entrance to the service plant exhibit is through a large thirty-five-foot plaster ring moulded in close representation and in exact duplicate size of the stationary armature of the 5,000-kilowatt, alternating-current Westinghouse generators constructed for the elevated and subway train service in New York city.



CORNER VIEW, PART OF WESTINGHOUSE ELECTRIC EXHIBIT, PALACE OF ELECTRICITY.

The total space devoted to the service electric plant in Machinery Hall, with the exciter units, condensers, cooling towers and the thirty-five-panel switchboard, is 26,260 square feet. The entire steam and electric station was designed and equipped by Westinghouse, Church, Kerr & Company, and all the motive power apparatus in connection with the generators and in the steam-generating plant in the near-by boiler house was furnished by the Westinghouse Machine Company. The electric plant, although within the Westinghouse walls at the west end of Machinery Hall, has not been laid out on elaborate lines to combine the diverse characteristics of exhibition and service, and is an exhibit plant only in so far as it is representative of thoroughly modern practice at minimum cost. The various organizations associated with the Westinghouse name, which have united in representation at St. Louis under the title of the "Westinghouse Companies at Louisiana Purchase Exposition," have additional adjoining exhibit space in Machinery Hall, of 26,260 square feet, space in the Palace of Electricity of 10,100 square feet, where Baldwin-Westinghouse electric trucks and locomotives also are shown, and space in the Palace of Transportation of 3,000 square feet, a total of 65,620 square feet, or nearly ten times the space occupied by the same interests at the Pan-American Exposition at Buffalo in 1901.

The Westinghouse exhibits and preparations for the reception and entertainment of visitors constitute a noteworthy feature of the industrial display at the exposition. In Machinery Hall, in addition to the electric service plant and the main exhibit of Westinghouse gas engines, turbo-generators, rotaries, exciters and motors in operation, all enclosed within ornamental staff walls and columned entrances of classic design, is the Westinghouse auditorium, which seats 350 persons, in which are displayed at regular hours through the day the biograph and mutoscope pictures of scenes in and about the various Westinghouse works in the Pittsburg district, including the first interior photography of the kind ever taken by means of the Cooper Hewitt mercury vapor lamp. Through the courtesy of the companies, this auditorium, which is of ornate architectural design, rendered cool and comfortable at all times by a ventilating system which provides a continual supply of pure air and brilliantly

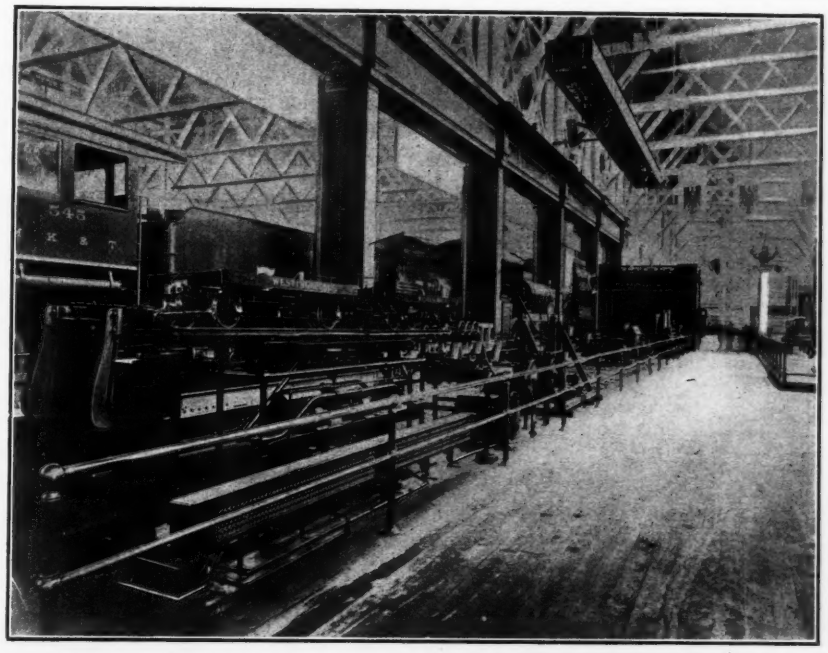


BALDWIN-WESTINGHOUSE ELECTRIC LOCOMOTIVES, PALACE OF ELECTRICITY.

lighted by the four principal systems of electric illumination, will be used throughout the fair as a meeting-place for scientific societies and technical congresses. The lighting of the hall is with the incandescent lamps of the Sawyer-Man Electric Company, Bremer arc lamps, Cooper Hewitt mercury vapor lamps and the Nernst glowers, all of which are used extensively throughout the Westinghouse display.

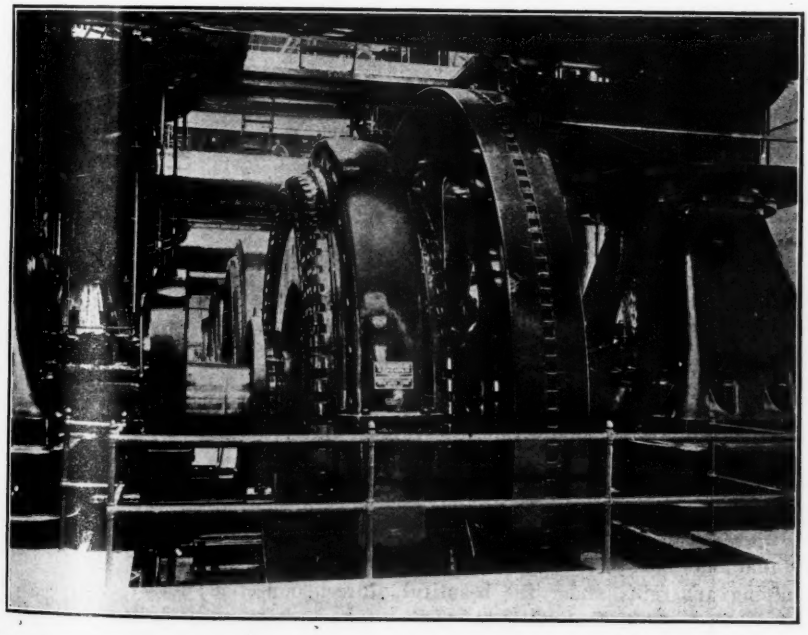
The Cooper Hewitt lamps are shown in the booths in Machinery Hall and in the Palace of Electricity, as designed for use in general illuminating, photography and photoengraving, with samples of work by some of the best operators in the latter line. Demonstrations of the lamps will be given for the benefit of the National Photographers' Association's convention in October. The lamps are in use on the grounds by the Official Photographic Company, and in an illuminated sign of the Robins Conveying Belt Company, in the Pike shows, "Over and Under the Sea" and the "German Tyrolean Alps," and in various exhibits. The most striking use of the lamp, however, is in the eight-foot tubes which are hung over the entrance to the Westinghouse auditorium, and over the entrance to the Cooper Hewitt booth in the Palace of Electricity.

There are in all about 10,000 Nernst glowers in use in the exhibition buildings, 6,000 of them in the Fine Arts Museum, where they effectively solve the problem of artistic illumination. The handsome Illinois State Building is lighted by them, the National Cash Register Company uses the glowers in its three displays in the Liberal Arts, Electricity and Education buildings, and the Westinghouse companies use 300 big street glowers in their exhibits.



WESTINGHOUSE BRAKE EXHIBIT, FROM MAIN AISLE, TRANSPORTATION BUILDING.

The Sawyer-Man company's display of various types and sizes of its well-known incandescent lamps is in the general Westinghouse exhibit space in the Palace of Electricity. There, also, the Bryant Electric Company shows a variety of lamp sockets, receptacles, switches and other products, including details manufactured by the Perkins Electrical Switch Manufacturing Company. The R. D. Nuttall Company's exhibit of cut and planed gears, trolleys, trolley gears and pinions for electric railway, mine and industrial haulage motors, is in Machinery Hall, near the Westinghouse headquarters.



VIEW THROUGH SHAFT APERTURE, CORLISS ENGINE, EXPOSITION SERVICE PLANT, WESTINGHOUSE EXHIBIT, MACHINERY HALL.

The Pittsburg Meter Company has a separate booth in block 35 of Machinery Hall. There the Keystone water meters and parts, with Westinghouse fish traps; Westinghouse gas meters; water meter provers; and a Westinghouse proportional twelve-inch gas meter of the new straight line type, with a capacity of 100,000 cubic feet an hour, are shown. A graduated assortment of Keystone water meters on a revolving pyramid frame, with a six-inch meter at the base and a one-half-inch meter at the apex, constitutes the moving feature of the display.

Steam for the Westinghouse electric service plant is piped from the boiler house, known as the Steam and Fuels Building, near-by, in which there has been installed under the direction of the same engineers and contractors a large battery of Babcock & Wilcox water tube boilers built into a single setting, with a total capacity of 6,400 horse-power. Equipment here includes also Roney mechanical stokers at the furnaces, operated by Westinghouse standard steam engines, a complete coal-conveying system furnished by the Link Belt Engineering Company, Cochrane feed-water

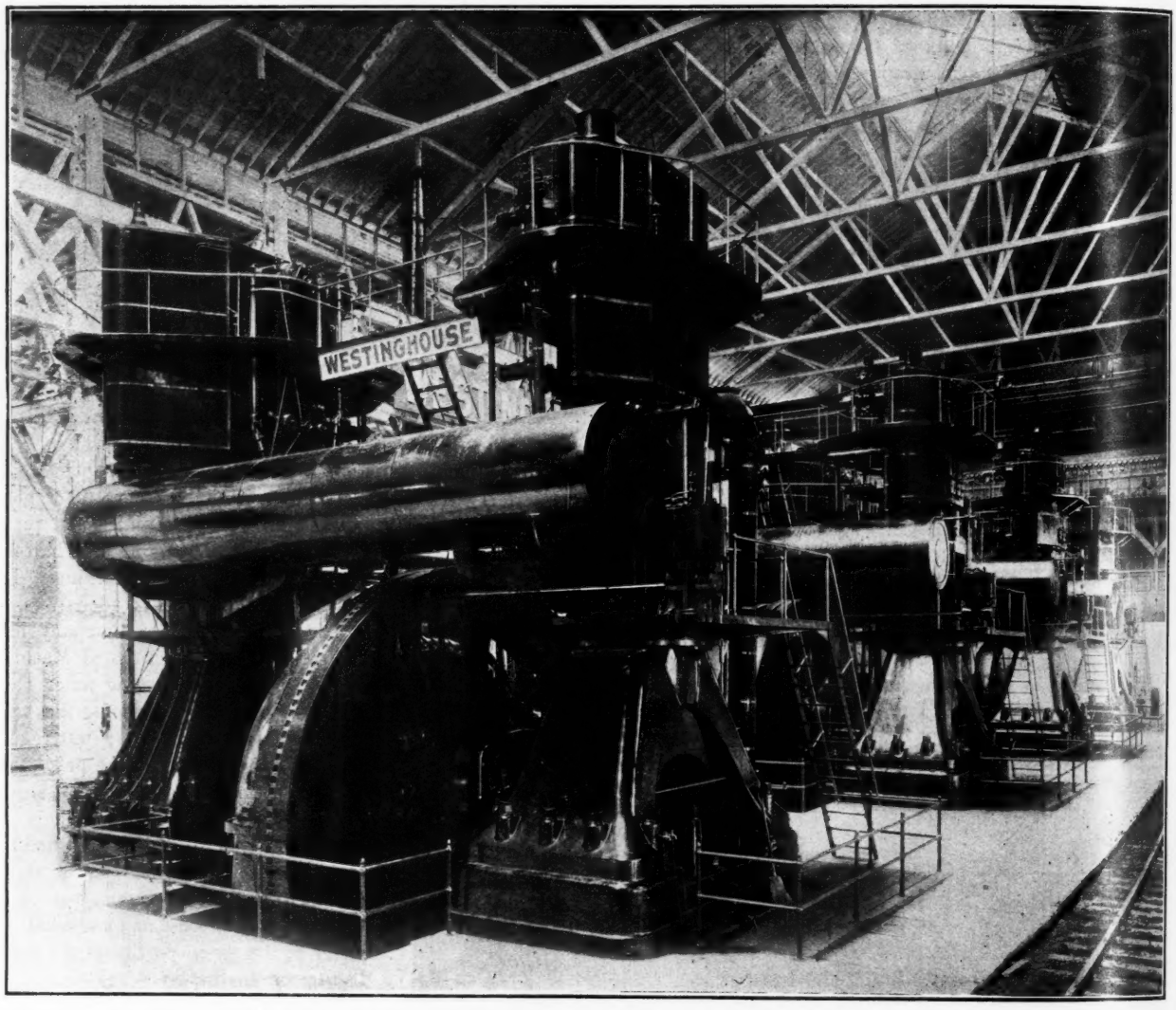
heaters, Worthington steam pumps, mechanical draught, condensers, cooling towers, and other apparatus to be found in a model station of the present day. The auxiliary apparatus in the electric plant includes three eighty-kilowatt, direct-current, 125-volt, direct-connected, engine-driven exciter units, two of which are sufficient to operate the entire plant and adjacent auxiliary machinery in the exhibit sections. Each of the four chief generating units receives steam from a separate line, supplied by a separate battery, the entire plant thus consisting of two sections, which may be operated independently or together.

The exhibit service plant, immediately west of the company's headquarters, is utilized to furnish power for various purposes, and includes a Westinghouse-Parsons steam turbine generating set of 400-kilowatt capacity, operating at a speed of 3,600 revolutions per minute, and delivering a three-phase, sixty-cycle current at a potential of 440 volts. The unit selected for exhibit is of a size that has met with most extended introduction by reason of its applicability to power stations of moderate size.

The horizontal engine will be of particular interest to engineers, as its development has been coincident with the introduction of gas power upon a large scale in this country. This engine may be regarded as strictly representative of the modern internal combustion motor in its most recent development.

An important part of the Westinghouse installation, which is seen by few, is the pumping apparatus under the beautiful cascades in front of Festival Hall. This equipment was designed to supply 90,000 gallons of water a minute for these cascades, by three large centrifugal pumps, each driven by a 2,000-horse-power Westinghouse induction motor.

In the Palace of Electricity, the Westinghouse Electric and Manufacturing Company occupies a space of over 10,000 square feet, including 1,600 square feet devoted to the display of electric trucks and locomotives constructed in conjunction with the Baldwin Locomotive Works. Two locomotives built for mine service are shown, one weighing 20,000 and the other 30,000 pounds, each equipped with two No. 79 motors at 500 volts. Another 20,000-pound locomotive, for switching, is equipped with two No. 75 motors at 220 volts. In the regular electrical equipment display are a 400-kilowatt turbine type generator; typical generators for direct and alternating currents, for belt or direct-connection; rotary converters; motor-generator sets; oil-insulated and air-blast transformers; direct-current and alternating-current railway motors and controllers; single and polyphase induction motors of constant and variable speeds; direct-current motors of many types, including motors for variable-speed service, from single and double-voltage cir-



EXPOSITION SERVICE PLANT, WESTINGHOUSE EXHIBIT, MACHINERY HALL.

cuits; switchboard apparatus, ammeters, voltmeters, wattmeters, synchroscopes, power-factor meters, circuit-breakers and switches, many of them electrically operated; portable instruments; instruments of precision; potential regulators, and innumerable other forms of auxiliary apparatus and instruments. The alternating-current, series-wound, single-phase crane motors, similar in type and general construction to the single-phase railway motors exhibited in the Transportation Building, and the new "Westinghouse Unit Switch System of Multiple Control" are also to be seen in this section. The spectacular high-tension sign, using a potential of 50,000 volts, which spells the name "Westinghouse" in lightning-like discharges radiating from large letters over a plate-glass surface—one of the attractions of the Pan-American Exposition—is to be seen in the Westinghouse auditorium.

The combined exhibit of the various Westinghouse brake companies extends for 150 feet down the aisle from the turntable in the Transportation Building. At the end nearest the turn-table is a reception room for guests, and at the other end is a booth fitted up as a Russian kiosk by the Westinghouse Company, Limited, of St. Petersburg, to be used as a rendezvous for Russian visitors to the fair. Included in this operating exhibit is the display of the Westinghouse Electric and Manufacturing Company's alternating-current, single-phase railway motors.

The Westinghouse Air Brake Company's exhibit shows a rack made up of apparatus constituting the equipment for a six-coach passenger train with engine and tender, all fitted throughout with the high-speed brake and signal equipment. The engine and tender are equipped also with the combination automatic and straight air brake which is now so much in use. The method at present generally adopted when two pumps are used on one locomotive is shown, and one of the novel features of the rack is that all valves are placed in duplicate, one sectioned so as to show the internal working mechanism, and connected to the valve in such a manner that it moves as the regular valve is operated. The operation of the various valves is thus readily studied.

The Westinghouse friction draught gear also is shown in section, with a machine especially designed for testing it in operation. The available power which can be exerted on the draught gear approximates 2,000 pounds. A triple valve testing rack is presented to show the manner in which this device is now being installed in many railroad shops. Sectional parts also are shown of the other apparatus of the Westinghouse Air Brake Company and the Westinghouse Traction Company. The latter's exhibit consists of the magnetic brake and car-heating apparatus and the straight air brake for both motor-driven and axle-driven compressors. The magnetic brake is applied to a truck operated on a track forty-five feet long, the truck being equipped on both ends with friction draught-gear buffers, showing the use of this device which has become extensively adapted to this kind of service. In this connection also is shown the separate brake controller for use with the magnetic brake when it is decided to add the latter to street railway equipment, having ordinary controller for the motor.

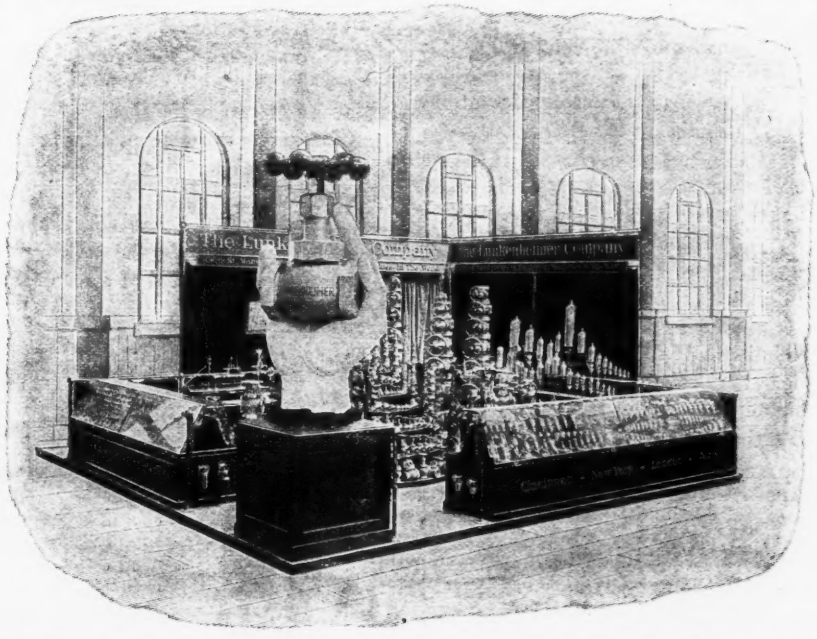
The straight air-brake rack shows the equipment now used in the straight air outfit on electric cars that are operated by one of its standard compressors. The compressors shown are of the axle and motor-driven types, in section for inspection of their internal working parts. One of the sectional compressors is fitted to move with a regular compressor in operation.

Swinging picture frames are hung from a pipe frame to show photographs and colored instruction charts which portray the equipment made by the Westinghouse Traction Brake Company, the colors representing the different pressures during the operation of the brake. In the exhibit of the American Brake Company is shown a model of the outside equalizing brake for locomotives, and the American automatic slack adjuster. The Westinghouse Automatic Air and Steam Coupler Company shows the ends of two freight cars fitted as movable models to show the operation of the device in actual practice. This also is shown on two small models fitted with air and steam and signal coupler. Under this model is another working model of the magnetic brake, arranged to show the operation of the device.

The Union Switch and Signal Company's exhibit is a group of signals, full size and in working condition, erected in the Transportation Building. The company shows also examples of electrical apparatus for the operation and control of signals, photographs of various installations, and a signal designed for use in the tunnels of the Pennsylvania Railroad under the Hudson river to New York city shown in position in a full size model of one of the tunnel tubes. The company's most important exhibit at St. Louis, however, is in installations in actual service, including the Westinghouse electropneumatic interlocking system at the big Union station, which controls all of the passenger yard movements.

The Lunkenheimer Exhibit at St. Louis.

The unique exhibit of the Lunkenheimer Company, Cincinnati, is situated in Machinery Hall, in block 26. The exhibit is easily identified by a large model of the company's familiar "Valve in Hand," which occupies a prominent corner of the exhibit. This may be seen in the accompanying illustration. Pyramids of globe, angle, cross, lever and gate valves of various designs and sizes, both in brass and iron, are artistically arranged about the exhibit, and these are agreeably offset by a black plush curtain at the side and rear.

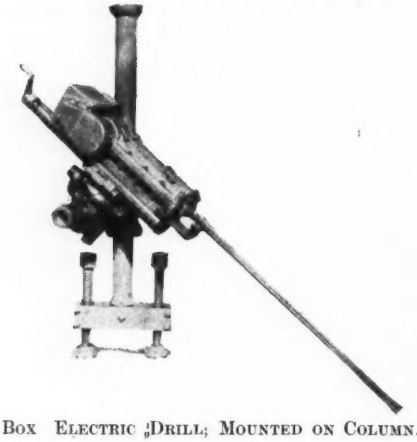


THE EXHIBIT OF THE LUNKENHEIMER COMPANY, CINCINNATI, OHIO, AT THE WORLD'S FAIR.

The glass cases arranged in front of the exhibit contain a smaller class of goods manufactured by the company, such as lubricators, oil and grease cups, cocks, etc., of all sizes. Neat designs of racks containing various sizes of whistles, injectors, pop valves and a variety of other specialties increase the exhibit value of this booth. New designs of water gauge and oil pumps for cylinder lubrication are features in themselves. In addition to this there are distributed about the exhibit pipe fittings of every description, together with whistles, safety and check valves and numerous other appliances.

An Electric Air Drill.

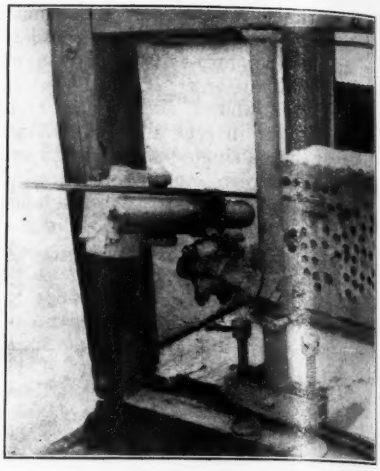
In the ordinary air drill, it will be remembered, the drill forms a part of the connecting rod of the air piston, the piston itself, with its rod and the drill attached, being forced to and fro by the reciprocating action of the cylinder, the air being alternately on each side of the piston, as in the reciprocating steam engine. In electric percussion drills the action of the reciprocating piston has been imitated as closely as possible, motion being transmitted to the drill through a carriage to which it is attached, the carriage receiving motion from the electric motor through beveled gearing and a flexible shaft. In the "Box" electric drill, made by the Denver Engineering Company, Denver, Col., the construction of the reciprocating drill has been departed from,



Box Electric Drill, Mounted on Column.

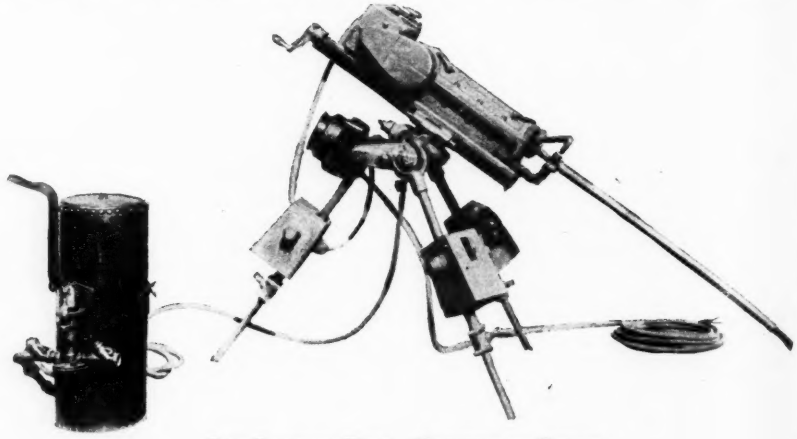
Box Electric Drill, Showing Driving Gears.

and a return to the principle of the hand hammer and drill. With man-power, no machine has yet beaten the man wielding a sledge against the head of a drill held in position by his mate. In the "Box" electric drill, this principle rules. The drill is loose, held in the hole and in position for the hammer by a chuck similar to those used in a lathe. The head of the drill is struck by the hammer just as it would be in hand drilling, but the hammer in this case is the head of a stout piston rod, and it is moved by the air, which is compressed behind it. The apparatus consists of the usual essential parts, an outer containing-case, in which works an air cylinder, with a piston inside. But the cylinder and piston are both movable. The piston is loose in the cylinder, and the cylinder is loose in the case. The cylinder is connected through a crank shaft to the motor, which forms part of the equipment, and it works to and fro, just as a piston does in the reciprocating engine cylinder, as the crank moves round. The head of the drill projects through the front of the cylinder, ready for the blow which the piston will administer. As the crank shaft turns, the cylinder moves forward toward the piston, compressing the air which is confined in the space between the rear end of the cylinder and the rear end of the piston. When the air is compressed to a certain figure, the piston is thrown forward against the head of the drill, its piston rod striking the drill just as the hammer in the hand of a man would, but striking it more certainly and more truly, provided that the drill chuck is kept in order. The motion of the piston forward compresses the air in front of it, and this is assisted by the motion of the air cylinder, which commences to return as soon as the blow has been struck on the drill head. The air cylinder and the piston return to the first position ready for another forward stroke, which is given, with its accompanying blow on the drill head as before. The drill itself recoils, naturally, after it has been struck, and its recoil is assisted by the motion of the air in the cylinder behind it. The drill is turned continually as the apparatus works by motion transmitted to the drill chuck by means of spur gearing between the chuck and a shaft which receives motion from the motor. This again is the practice with hand drilling. After each blow the holder turns the drill a portion of a revolution, so that fresh parts of the drill point are presented to the rock face at each blow. The feed is accomplished by moving the whole apparatus forward as the hole deepens, in the usual way, by means of a screw attachment to the case and the clamp which supports it on the drill pillar.



Box Electric Drill, Showing Hinge Arrangement.

It is claimed that this drill works with one and one-half horse-power, all told, as against twelve horse-power required at the compressor with the ordinary air drill. One of the great troubles in connection with labor on the Rand has been due to the drilling question. The black who is available in South Africa is quite as good for hand drilling as the white who is available, and he costs very much less. Under the peculiar conditions of working, the hand drilling process with black labor is cheaper than machine drilling, mainly on account of the greater flexibility of the hand drilling process. The lode winds about, and changes its thickness and its shape in a most exasperating manner. Hand drilling can follow this, machine drilling can not so easily.



Box Electric Drill, Mounted on Tripod.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

NEW MICHIGAN ELECTRIC POWER PLANT—Plans to develop a thousand horse-power from the Intermediate river, near Bellaire, Mich., and to furnish Charlevoix and other surrounding towns with current for lighting and power purposes are being projected. It is very likely that a new power plant will be built at this place to furnish alternating current.

ALABAMA WATER POWER PLANS—The Cherokee Development and Mining Company has perfected plans to build a large water power plant at Cherokee Bluff, on the Tallapoosa river, and to supply electric power to the city of Birmingham, eighty-five miles away. It is proposed to develop 25,000 horse-power to augment the power now used there. The river will be obstructed by a dam of granite 100 feet high.

THE KERN RIVER POWER PLANT STARTED UP—Los Angeles (Cal.) was connected on the evening of July 2 with the Kern river transmission line, 128 miles long. The line has been completed by the Kern River Light and Power Company from the power station at Borel, on the Kern river, where power is developed by means of water-wheels twelve miles further up the stream. The ultimate voltage will be 65,000. The power will be used by the electric railway systems in Los Angeles, Pasadena, Pomona, Riverside, San Bernardino and other places.

MORE EQUIPMENT FOR THE SAO PAULO HYDRAULIC PLANT—The Sao Paulo Tramway, Light and Power Company, Limited, has awarded an important contract for further equipment to be installed in the hydraulic plant on the Rio Tiete, located about twenty-five miles from Sao Paulo, Brazil. The additional machinery will include a 2,500-kilowatt generator for direct connection to a water-wheel of 4,000 horse-power capacity. The existing equipment, together with what is now ordered, will make the capacity of the Rio Tiete plant 10,000 horse-power.

AMERICAN MACHINERY FOR NEW ZEALAND TRAMWAY—The Auckland (New Zealand) Tramways Company, which is now controlled by the British Electric Traction Company, and which operates an electric traction system in Auckland, New Zealand, is to extend its power-house. The capacity of the plant will be increased from 1,500 to 2,500 horse-power. The existing equipment is largely of American manufacture. The line was built by the London interests of the electrical engineering and contracting firm of J. G. White & Company, New York city. Twelve additional cars will also be employed on the system.

ELECTRICAL SUBWAY COMPANY WINS SUIT—The application of the West Side Electric Company, of New York, for a mandamus to compel the Consolidated Telegraph and Electrical Subway Company to grant it the right to use the Consolidated company's subways for the laying of wires was dismissed on July 8 by Supreme Court Justice Truax. The alternative mandamus which had been previously granted, and because of which the application for a peremptory mandamus was argued, was also disposed of. Justice Truax was of the opinion that the consent of the municipal authorities is necessary to enable any concern to lay wires or other conductors for either gas or electricity, and as the municipal authorities have refused to acknowledge the West Side company's rights, a mandamus could not lie against the rival company.

MICHIGAN TELEPHONE COMPANY'S EXTENSIVE PLANS—The Michigan State (Bell) Telephone Company is about to begin extensive improvements to its existing lines, and will also install several new circuits. The Michigan State company has a large system in Marquette County, in which it serves all cities and towns, and in the city of Marquette alone a few years ago it expended almost $100,000 in improvements. Long-distance lines radiate to the east, that to Sault Ste. Marie and St. Ignace bringing the county in touch with Detroit and intermediate points. It also has connection to the south through Escanaba, Menominee and other communities. It is not intended merely to improve the state lines, but radical changes will be made in the lines and central office equipment, so that international connections may be accomplished.

MEXICAN ELECTRICAL NOTES—The American-Mexico Company, Chicago, Ill., is planning extensive power improvements at Velardena, state of Durango, Mexico, for the purpose of operating the two smelters which are to be constructed by the company, and also drive machinery in the mines in that locality. Manuel Cuevas, who has extensive water concessions in the state of Jalisco, Mexico, is making arrangements to begin construction work. The concessions permit of the utilization of water from Lake Chapala sufficient to irrigate 300,000 acres. The pumps which will distribute the water through irrigation canals will be operated electrically. The power will be supplied from a plant which will be built on the Santiago river. The Mexican Light and Power Company, Limited, has awarded a contract for 1,500 miles of wire. This will be used on the 125-mile transmission line which the company is constructing from its Necaxa plant to Mexico City and El Oro mining camp. A company has been formed to build an electric lighting plant in the territory of Tepic. Mr. Alfred Lonergan, an Englishman who has been identified with mining and agricultural interests in Tepic for a number of years, is at the head of the company.

ELECTRICAL DEVELOPMENTS IN CUBA—The Cienfuegos, Palmyra & Cruces Railroad and Electric Power Company, which was organized last fall for the purpose of constructing and operating an extensive electric railway system in southern Cuba, and for lighting a number of cities and villages in that vicinity, is to award contracts for material and equipment representing an expenditure of some $500,000. The company is composed mostly of Cuban capitalists. There are also some Germans in the company. Mr. Bruno Diaz, of New York city, is president, and Mr. Cornelius C. Vermeule, also of New York city, is the consulting engineer. The company will build an electric traction system in Cienfuegos. Power will be developed at Hanabanilla Falls. These are located about thirty miles from the city of Cienfuegos. The available fall is 470 feet. The initial plant, for which contracts are to be let, will have a capacity of about 4,000 horse-power. Eventually additional equipment will be put in which will bring the development up to 10,000 horse-power. The company will take over the local company operating the lighting system, which has at present 3,500 incandescents in use. This number will be doubled, and 250 arc lamps will be installed for street lighting.

TELEPHONE AND TELEGRAPH.

SHILOH, GA.—The Southern Bell Telephone Company has completed the extension of its telephone line from Waverly Hall to Shiloh.

PRATT CITY, ALA.—The People's Telephone Company is extending its lines to Sandusky and is also making extensive improvements to its service in this city.

WASHINGTON, D. C.—The Southern Telephone Company will build a line to connect Leonardtown, Md., with Mechanicsville, by way of Laurel Grove and Morganza.

TRENTON, N. J.—Poles have been set as far as Millhurst by the North Eastern Telephone Company, which was recently granted permission to build a line from Freehold.

BLUE SPRINGS, NEB.—The Gage County Independent Telephone Company has commenced the erection of two new lines, one running south into Kansas, and the other west to connect with a line already in operation.

MONTREAL, CAN.—The first of the seven wireless stations that are being constructed by the Marconi company under agreement with the Canadian Government has been opened. It is on Fame Point, 320 miles below Huebre.

WASHINGTON, IND.—F. D. Grismore and D. E. Elliott are constructing a telephone line forty miles in length in the southeastern part of Daviess county. The line when completed will connect Alfordsville, Glendale, Hayesville, Waco, Whitfield and Loogootee,

and will tap a country which is only partly reached by telephone at the present time.

ALBANY, N. Y.—The Hudson River Telephone Company is making numerous extensions to its service, underground conduits being constructed in Newburgh, Middletown and Saratoga. A line is also being built from Saranac Lake to Malone.

KALAMAZOO, MICH.—The Michigan State Telephone Company is building a new line from Hartford to Benton Harbor, on which there will be four circuits. Two new circuits are also to be added between Hartford, South Haven and Kalamazoo.

CHICAGO, ILL.—The Illinois Central is to expend $500,000 in reorganizing and improving its telephone system. Wires weighing 400 pounds to the mile will be substituted for those of 175 pounds, now in use. The system is also to be extended over the Omaha division.

LOS ANGELES, CAL.—The Sunset Telephone Company is preparing for improvements in its system at Santa Monica, which will involve the expenditure of $20,000. A new line is to be put in and new phones are to be set in the East Santa Monica Land and Water Company tract.

CHEYENNE, WYO.—The Rocky Mountain Bell Telephone Company has commenced work on new lines which will connect all isolated districts. These will extend from Burlington to Germania, Burlington to Otto, and Burlington to Fenton. A line from Basin will also be constructed up the Big Horn river.

COLUMBUS, OHIO—It is stated that the capacity of the Columbus Citizens' Telephone Company will not be increased until after January 1, 1905, as its new building will not be completed until November 1. The new plant will have a minimum capacity of 8,000 telephones, and this can be increased to any desired number.

CARROLLTON, GA.—The Gainesboro Long-Distance Telephone Company, of this city, announces the completion of its extension from Cedartown, Ga., to Borden Springs, Ala., a line eighteen miles in length. The telephone company has also completed a double circuit on the Atlanta and Jackson, Ga., branch of its system.

CLEVELAND, OHIO—At the annual meeting of the Cleveland Telephone Company the following officers were elected for the ensuing year: Frederick P. Fish, president; H. J. Pettengill, vice-president; P. Yensen, general manager; Charles A. Grant, secretary; James P. McKinstry, treasurer; John Balch, assistant treasurer.

LINTON, IND.—The Central Union Telephone Company is making many improvements to its system in the vicinity. A new switchboard has been installed in this city, and copper circuits erected to Terre Haute, Brazil and Vincennes, and the company intends in the near future to connect with Midland and Jasonville.

PITTSBURG, PA.—The Central District and Printing Telegraph Company has opened a new exchange at Carrick, on the Suburban trolley line, some distance south of Mt. Oliver. The new exchange is considered part of the Pittsburg city district; is to be known as Carrick, and covers a territory of about four square miles heretofore entirely without telephone connection.

WEST PLAINS, MO.—Work is now being pushed on the new telephone line between West Plains and Willow Springs, *via* Olden and Pomona. This line is owned jointly by C. H. Gale, of the West Plains Telephone Company, and W. N. Wicks, of the Willow Springs Telephone Company. Several other lines are under construction in Howell county. Frank Crowly, of Bly, who owns the line to Gainesville and also from Bly to Moody and Viola, is building an independent line to Bakerfield to connect with his other lines at Bly. The new line east from this city to the county farm and Chapin *via* the Carson mine, is in operation. It is owned by the West Plains Telephone Company.

DENISON, TEX.—Arrangements have been made for the stringing of two new telephone lines, which will connect the Southwestern Telegraph and Telephone Company, of this city, with new points in the Indian Territory and Oklahoma. The American Telegraph and Telephone Company, with headquarters in Chicago, will build from Lawton, Okla., to Denison, and from Lawton to Joplin, Mo. The Missouri & Kansas Telephone Company, which is practically a dependent company of the American, will string a line from Pulcell, I. T., direct to Denison. It is expected that the new lines will be in operation and all cities en route connected up by September 1.

ELECTRIC LIGHTING.

GREENE, IOWA—A company has been formed to purchase and operate the electric light plant.

STILLMORE, GA.—Wires are now being strung through the town for an electric light plant, backed by local capital.

TONAWANDA, N. Y.—The Tonawanda pumping station has completed the installation of an electric lighting plant for its own use.

CLINTON, LA.—The Clinton electric light and ice plant has been sold at sheriff's sale to Isidor Mazen. A new company will be organized by local interests.

RUSHFORD, MINN.—The city council has closed a contract for enlarging the municipal electric plant, the work to be completed within sixty days, at a cost of $2,784.

DARTMOUTH, NOVA SCOTIA—Operations on the new day plant of the Electric Light Company have been begun, and it is hoped to have the station in operation by September 1.

DENVER, COL.—The work of constructing an electric light line to Fort Russell has been commenced. All of the new buildings, being erected at a cost of $800,000, will be wired.

BEDFORD, MASS.—The electric lighting system for the streets of this town has been placed in operation. Thirty-candle-power incandescent lamps are used, burning from sunset until 1 A. M.

LAKEVILLE, CT.—The electric light plant on the grounds of the Hotchkiss school has been totally destroyed by fire. The loss is estimated at $20,000, which is covered by insurance. The plant will be rebuilt immediately.

BIRMINGHAM, ALA.—The aldermen of East Lake have granted a thirty-year franchise to the Birmingham Railway, Light and Power Company, and the company will at an early date install a system of electric lights in the town.

NIAGARA FALLS, N. Y.—The plans for the Ontario Power Company's power-house have been approved by the commission of the Niagara Falls Victoria Park. The length of the power-house will be 1,000 feet, built in three sections.

FOND DU LAC, WIS.—At a recent meeting of the North Fond Du Lac village board a movement toward erecting a lighting plant for the village was launched. It was decided to lay the question before the people, and a special vote will be taken.

PORT JERVIS, N. Y.—The village has entered into a contract with the Port Jervis Electric Light, Power and Gas Company for lighting the village streets, at $9,896.56 per year. The company also agrees to furnish light to private consumers at ten cents per kilowatt-hour.

CINCINNATI, OHIO—The Cincinnati Gas and Electric Company announces that $1,740,004 of treasury stock will be floated to pay for that amount of improvements made the past year or to be completed this summer. The stock is offered at par, and is part of the $2,000,000 issue authorized a year ago.

BATH, N. Y.—The Bath Electric Light and Power Company has contracted for a new dam in the Conhocton river to cost $4,000, replacing the one damaged by floods last spring. This is taken to indicate that the company intends to resume the day service, which was discontinued several weeks ago.

BALTIMORE, MD.—The Baltimore county commissioners have awarded to the Baltimore County Water and Electric Company the contract for lighting Highlandtown and Canton for five years. Ninety dollars a year will be paid for each arc light, and $22.50 for thirty-two-candle-power incandescent lights.

VANCOUVER, BRITISH COLUMBIA—The British Columbia Electric Company, operating the electric lights in Vancouver, New Westminster and Victoria, has acquired the business and plant of the Vancouver Gas Company, and announces a reduction on present charges for lighting of twenty per cent.

OAKLAND, CAL.—The power plant on the State University grounds is to be enlarged at a cost of $10,336 for the additional building alone. The work is to commence immediately. The contract stipulates that the work must be completed by November 5, 1904. Until recently the power plant has been sufficient for the demands upon it, but with the construction of new buildings the

enlargement is necessary. The plant furnishes light to the buildings and grounds.

BELOIT, WIS.—The common council of Beloit has entered into a contract with the Beloit Electric Company, a branch of the Milwaukee Gas Light Company, for street lights for ten years. The most improved electric light will be furnished as follows: One hundred lights till one o'clock at $65; ten lights all night at $85.

STUART, VA.—The Electric Light and Power Company, with a capital of $5,000, has received its charter. Its officers are John Axford, president; J. M. Hooker, vice-president, and E. J. Harvey, secretary and treasurer. It is the purpose of the company to have the plant in working order and the town lighted by September 1.

MUNCIE, IND.—It is understood that the American Electric Company, which purchased the plant of the Muncie Electric Light Company, in this city, will begin in the near future to make extensive improvements. It is said that the service will be extended to all parts of the city and the capacity of the plant greatly increased.

ROCKFORD, ILL.—The directors of the Central Heat and Power Company will install electrical equipment to cost $40,000 in its plant on Chestnut street, near the river. The company is planning to branch out in several ways, and the heating plant will be enlarged to meet the demands made upon it. Two new boilers have been ordered.

WORCESTER, MASS.—The selectmen and the officials of the Milford Electric Light and Power Company have effected a compromise as to the price of electric arc light in Milford, temporarily, and it is agreed that the lights shall serve on a moonlight schedule, the price of each arc light to be $75 per year, instead of $100, which has been the price several years.

WEST CHESTER, PA.—It is announced that within sixty days the extensive electric plant being erected by the Ridley Creek Supply Company will be in operation. The plant, which is to furnish electric power and light to Malvern, Duffryn Mawr, Paoli and other points on the Pennsylvania Railroad in that section, will be one of the largest and most complete in eastern Pennsylvania.

SUMPTER, ORE.—The new power plant of the Sumpter Light and Water Company has been started up. Underground conductors convey the power from the station on Powder river to the town, a distance of four miles. The old plant was run by steam, and its operation proved to be very expensive. Additional dynamos have been installed, and the plant is now complete in every respect.

CHICAGO, ILL.—First payment of compensation to the city under its fifty-year ordinance has been made by the Commonwealth Electric Company in a check for $38,972.97 deposited with the city collector. This sum is three per cent of the gross receipts from the operation of its plant from June 1, 1903, to May 31, 1904, the sixth year of operation. The gross receipts from operation are given as $1,299,098.98.

NEWBURYPORT, MASS.—Work on the municipal power and light plant, which is being put in the town of Merrimac is progressing well, and the indications are that the plant will be in working order by September of this year. About 200 of the poles, out of the proposed 400, have already been set. There will be over 300 street lights, and over six miles of streets will be lighted. The installing of the entire electric plant is estimated to cost about $11,000.

BEL AIR, MD.—The Glencove Power Manufacturing and Supply Company, of Harford County, which secured a charter at the last session of the Maryland legislature, has organized by electing the following officers: president, Charles A. Andrew; secretary and treasurer, Jas. T. Jones. Charles H. McComas was elected attorney and the incorporators were chosen as directors for the first year. The incorporators are Charles A. Andrew, Daniel H. Carroll, James T. Jones, Harry I. Rowe and Charles H. McComas. The company is authorized under its charter to generate and supply electric current, erect and maintain the necessary poles and lines for the conveyance thereof, and to engage in the business of generating and furnishing electric current for all purposes. It is also authorized to build and operate steam or electric railways within the limits of Harford County.

NEW INCORPORATIONS.

YOUNGSTOWN, OHIO—Niles Electric Company. $100,000.

SENATOBIA, MISS.—Tate County Telephone Company. $1,000.

LINCOLN, NEB.—The Cushing Independent Telephone Company. $5,000.

CHICAGO, ILL.—Galesburg Railway and Light Company. $1,500,000.

INDIANAPOLIS, IND.—Eureka Telephone Company. Increased from $10,000 to $15,000.

MECHANICSBURG, VA.—Mechanicsburg Telephone Company. $5,000. J. Burton, president.

MADISON, WIS.—The Farmers' Independent Telephone Company. Increased from $1,000 to $2,500.

EAST RANDOLPH, N. Y.—East Randolph Telephone Company. $10,000. Directors: Rollin Dow and others.

TRENTON, N. J.—The National Gas, Electric Light and Power Company. Increased from $10,000 to $4,000,000.

ALTON, ILL.—The Davis Electric Company. $2,000. Incorporators: C. B. and R. E. Davis, and C. E. Whitney.

MORRISONVILLE, ILL.—Morrisonville Electric Company. $6,000. Incorporators: William Lewis, J. D. Lewis and T. C. Cloyd.

NASHVILLE, TENN.—The Greystone Telephone Company. $500. Incorporators: H. Johnson, Wiley McCoy, Sparling Bowman and others.

BERNE, IND.—Berne Electric Light Company. $6,000. Directors: H. H. Stucky, Fred K. Shaefer, H. Michaud and Fred Maderhauser.

FORT WAYNE, IND.—The Wayne Water Power Company. $100,000. Directors: John H. Bass, John W. White and William A. Fleming.

MORGANSVILLE, N. Y.—Stafford Telephone Company. $3,000. Incorporators: Jay Lathrope, James Wright, W. S. Daniels, all of Morgansville.

UNION BLUFF, TEX.—Union Bluff Telephone Company. $225. Incorporators: G. H. Garrett, H. Daniell, H. D. Bookout and R. T. Bookout, of Hillsboro.

WILLIAMSTOWN, N. J.—Williamstown Electric Company. $25,000. Incorporators: Herbert B. Garwood, Samuel Garwood, John S. Weaver, Williamstown.

WALTER, O. T.—The Walter Light and Water Company. $5,000. Incorporators: W. H. Cox, R. S. Reid, W. E. Oakes, C. L. Loucks and Henry Brendzen.

COLUMBUS, OHIO—The West Millgrove Telephone Company. $3,000. Incorporators: W. W. Rosendale, J. P. DeWolfe, C. D. Stearns, J. C. Rhodes and S. S. Ghaster.

COLUMBUS, OHIO—The Wren Telephone Company. $10,000. Incorporators: J. L. Moser, F. M. Lichensteiger, B. O. Jones, L. M. Harmon, O. J. Harmon and E. L. Sheets.

CHATHAM, OHIO—The Chatham Farmers' Mutual Telephone Company. $100,000. Incorporators: A. B. Horst, John Yoder, Jr., W. H. Ripley, D. A. Clapp and A. R. Clapp.

WILMOT, IND.—The Wilmot Telephone Company. $10,000. Incorporators: L. R. Gerrard, J. W. C. Scott, H. T. Kline, George S. Bouse, G. F. Brenninger, M. L. Hussey and R. R. Scott.

PORT ARTHUR, TEX.—Pleasure Pier Traction Company. $10,000. Incorporators: S. O. Latimer, John A. Young, D. L. Burch, C. A. Fisher and George W. Woodworth, all of Port Arthur.

SANTA ROSA, CAL.—Mark West Creek & Santa Rosa Creek Telephone Company. $15,000. Directors: R. W. Peterson, H. L. Hall, J. M. Laughlin, C. V. Talmadge and S. W. Purrington.

ROCKY RIVER, OHIO—The Rocky River Water, Light and Power Company. $75,000. Incorporators: Christian Burkhardt, Charles P. Corlett, E. H. Richards, E. Meunier and Robert Fisher.

SANTA FE, N. M.—Artesia Telephone Company. $25,000. Incorporators: Harry W. Hamilton, Samuel P. Denning, James A. Cottingham, of Roswell, and John R. Hodges and Mark Smith, of Artesia.

WAXAHACHIE, TEX.—Mutual Telephone Company. $50,000. Incorporators: John M. Harrison, of Waxahachie; P. M. Wheatley and W. A. Lewis, of Howard; W. A. Culbertson, of Sterrett, and J. B. Wiley, of Ovilla.

ELECTRIC RAILWAYS.

DES MOINES, IOWA—Preliminary surveys have been begun for the proposed St. Joseph-Des Moines road.

SPRINGFIELD, ILL.—The Central Illinois Traction Company has been granted a fifty-year franchise by the city council.

MARSHALL, MO.—The Swope park electric line is to be extended to Belton, a distance of twenty-three miles. It will take in Holmes park and Hickman's Mills.

PEKIN, ILL.—The Peoria & Pekin Terminal Railway will raise the roadbed between Pekin and Hollis, a distance of one and one-quarter miles, at a cost of $30,000.

LEECHBURG, PA.—The contract for building the electric road from Apollo to Leechburg and on to New Kensington has been let. The power-house will be located in this city.

SAN DIEGO, CAL.—E. S. Babcock has been granted a franchise to install an electric railway system in this city. Work is to begin within ninety days and be completed in nine months.

FREEPORT, ILL.—Work on the electric line from Freeport to Dixon will be started in September, and the promoters hope to have it in operation within twelve months. It is stated that sufficient capital has been secured to build the road.

HARRISBURG, PA.—A charter has been issued to the Elk Street Passenger Railway Company to construct a line seventeen miles long in Elk County, connecting Ridgway, Whistletown, Johnsonburg and St. Marys. The capital is $102,000.

BALLSTON, N. Y.—The Schenectady Railway Company's branch line to this place, sixteen miles in length, has been opened for traffic. The schedule provides for cars to leave each terminus every half hour, and connect here with the Hudson Valley Company's line to Saratoga and Round Lake.

ARCOLA, MANITOBA—Residents of Moosomin, Arcola and Alameda have under consideration the matter of building an electric road to connect the three places. The intention is to carry freight as well as passengers. Provision would also be made for the lighting of towns adjacent to the line and the supplying of power for various industries.

LOS ANGELES, CAL.—It is announced that cars capable of making a speed of sixty miles an hour are to be placed in service on the Los Angeles-Pacific Electric Railway, for use in the regular passenger traffic. The new cars are to run on all the divisions of the road, though most of them will be placed on that section between Los Angeles and Santa Monica.

YORK, PA.—It is thought the electric line to York Haven will be in operation early in August. The work of grading between York Haven and the Conewago is progressing satisfactorily and track laying will commence shortly. Surveys are still being made for the prospective line to Hanover, but there is as yet no certainty that construction work will be begun this season.

SPRINGFIELD, OHIO—It is reported that the American Railways Company, of Philadelphia, which owns the street railway line in this city, has obtained control of the Springfield & Xenia traction line. It is said that the deal involves the control by the same company of one of the lines between Xenia and Dayton, so that it will have a through line from this city to Dayton.

SPRINGFIELD, OHIO—G. H. Frey, Jr., states that he will, within the next few weeks, begin the construction of his electric line from this city to Wilmington, by way of Clifton, Jamestown, Cedarville, Bowersville, Port Williams and thence to Wilmington. It is his intention to start the work at this end of the line. Eventually a line will be run from Bowersville to Washington C. H. and another to Xenia.

WILMINGTON, DEL.—The work of extending the line of the Odessa & Middletown Railway Company to Townsend, Clayton and Smyrna has been commenced, and will be pushed to completion as rapidly as possible. The road will be thirteen miles long, and it is hoped that a new section will shortly be built connecting the Wilmington, New Castle & Southern Railway with this line. To do this it will be necessary to build from Delaware City to Odessa.

CHICAGO, ILL.—It is stated as probable that the Chicago, Burlington & Quincy Railroad, before the opening of 1905, will have in operation gasoline electric motors to compete with the interurban electric railways. It is understood that two motors are now under construction, one of which is to be placed in operation between Abingdon and Galesburg. Between Chicago and Aurora the Burlington is said to be losing through electric competition $5,000 a month.

LOUISVILLE, KY.—The Louisville & Eastern announces that it will extend its interurban line to Frankfort from Lagrange, a distance of twenty miles. This will be the shortest route from Louisville to Frankfort by twelve miles. The route will be by Pewee Valley, Anchorage and Beard. The company is now preparing to extend its line to Shelbyville, and has the survey made. Construction will begin at once, and the road will be completed from Beard to Lagrange this fall, and to Frankfort in the spring.

LA PORTE, IND.—The Indiana Railway Company, in which a syndicate of Pittsburg capitalists is interested, has outlined extensive plans for building operations during the coming year. The chief project will be the extension of the northern Indiana lines into southern Michigan counties and the establishing of connecting links with Michigan systems, joining Grand Rapids, Kalamazoo, Benton Harbor and Detroit. The Indiana systems are being built southward to establish communication with Indianapolis.

LANSING, MICH.—Articles of incorporation have been filed by the Battle Creek & Grand Rapids Inland Lakes Traction Company, capital $520,000. The purpose of the company is to build an electric road from Battle Creek through to Gull lake, Hickory Corners, Prairieville, Orangeville, Gunn lake, Yankee Springs, Bowen's Mills, Green lake, Crosby and Grand Rapids, a distance of sixty-five miles. The stockholders are residents of Battle Creek and the towns included in the route outside of Grand Rapids.

CHICAGO, ILL.—In order to complete the gap in the Chicago & Milwaukee electric railway which now exists between Racine and the north boundary of Zion City, the road has filed articles of incorporation at Madison, Wis. The gap will be filled soon, as the necessary right of way has now been secured. The present line from Evanston ends at Waukegan, though a right of way has been secured through Zion City. The north section of the road runs south from Milwaukee to the south boundary of Racine, and it is the aim of the road to complete this lacking section. The capital stock of the corporation is fixed at $300,000, most of which is controlled by Albert C. Frost, of this city.

BALTIMORE, MD.—The stockholders of the Baltimore & Belair Electric Railway Company have authorized the issue of $500,000 thirty-year five per cent gold bonds, with the International Trust Company of Maryland as trustee. The first section of the road, which is ultimately to reach from Baltimore to Belair, has about been completed from the present line of the United Railway terminus to Carney, in Baltimore County, a distance of eight miles, and the same will be operated under contract with the United Railways Company of Baltimore as soon as completed. Rails and crossties to complete the road to the Gunpowder river are on the ground, and work on this, the second section, will be begun as soon as the first section is in operation.

LEGAL NOTE.

SELF-REGULATING TRANSFORMER CASE—In the suit of the Westinghouse Electric and Manufacturing Company *versus* the Montgomery Electric Light and Power Company, Judge Coxe, in the United States Circuit Court for the Northern District of New York, granted a motion for a preliminary injunction on June 18, 1904.

OBITUARY NOTICES.

MR. CLARENCE W. PHILLIPS, president of the Premier Construction Company, electrical contractors, died at Glens Falls, N. Y., on July 8, of heart trouble. He had a wide acquaintance in the field and was thirty-one years of age.

JUDGE J. M. JONES died suddenly at his home in Cleveland, Ohio, July 11. He had long been prominent in legal circles and had served as counsel for the Western Union Telegraph Company. He was a common pleas judge for several years.

MR. L. W. BELGER, thirty-five years old, a well-known electrical engineer of Federal, Pa., died at the Homeopathic Hospital, Pittsburg, Pa., July 7, from heat prostration. Mr. Belger was on his way to the laying of the corner-stone for the new Masonic building at Carnegie, Pa. He was a member of Centennial Lodge, 544, F. & A. M., of Carnegie, and Chartiers Commandery, No. 78, Knights Templars.

PERSONAL MENTION.

LORD KELVIN celebrated his eightieth birthday on Sunday, June 26.

MR. J. B. WARE, of Grand Rapids, Mich., is now special representative of the Automatic Electric Company, of Chicago.

MR. W. W. BOSTWICK, JR., formerly with the Lambert Schmidt Telephone Manufacturing Company, has been appointed New York manager for the Couch & Seeley Company, Boston, Mass.

MR. BURTON E. LUCAS, who has been superintendent of the municipal electric lighting plant and waterworks at Ovid, Mich., for the last three years, has resigned to take charge of a similar plant in St. Louis, Mich. Mr. Richard L. Redding, of St. Louis, will go to Ovid.

MR. BARTON JONES has been appointed by the Southwestern Telegraph and Telephone Company as manager of the Moody (Tex.) exchange, in connection with his duties as manager of the system in Temple. Mr. Jones is receiving the hearty congratulations of a wide acquaintanceship in that part of the country.

MR. J. W. COFFEY, manager of the Home Telephone Company, of Crawfordsville, Ind., for the past two years, has resigned. He will take a vacation at his old home at Ellettsville, in the southern part of the state of Indiana, for a few weeks, when he has in mind a similar proposition in another part of the state.

MR. FRANK W. FRUEAUFF has been appointed general manager of the Denver (Col.) Gas and Electric Company. Mr. Frueauff is widely known in the lighting field, and was the author of a most interesting and instructive paper on accounting, delivered at the last meeting of the National Electric Light Association.

MR. R. PEACOCK, an Egyptian railroad man from Assiout, is visiting in the United States. He is locomotive superintendent of the Egyptian State Railways, and has come to the United States at the request of his government, to inspect American railways, with a view of introducing some of the modern American methods into his country.

MR. E. G. PIKE, for ten years manager of the Bay City (Mich.) exchange of the Michigan State Telephone Company, will go to Houston, Tex., where he has been appointed district superintendent. This district will include Galveston and other large cities in Texas. Mr. Pike has been in the employ of the Bell Telephone Company for twenty-two years.

MR. RICHARD EICK, until recently a division superintendent of the United Railroad, of San Francisco, has been appointed division superintendent of the Public Service Corporation of New Jersey. He will be in charge of the company's Elizabeth division. Prior to his connection with the San Francisco railroad he was connected with the North Jersey Street Railway Company.

MR. A. J. CAMPBELL, for several years general manager of the Norwich (Ct.) Gas and Electric Light Company, gave a farewell banquet to the employés on Thursday, June 30. The new superintendent of the plant under municipal control, Mr. F. S. Thayer, and Mr. H. L. Merry, of New York, were guests of Mr. Campbell. At the conclusion of the banquet Mr. Charles S. Hyde, on behalf of the employés of the company, presented Mr. Campbell with a handsome gold masonic ring.

ALBERT SCHMID, director-general of the Societe Anonyme Westinghouse, of Havre, France, which concern looks after the Westinghouse interests in various parts of Continental Europe, is now on a business trip to this side. Mr. Schmid was at one time general superintendent of the Westinghouse Electric and Manufacturing Company at East Pittsburg. H. L. Kester, formerly of the Westinghouse Electric and Manufacturing Company, of Pittsburg, and now connected with the French company, is also on a visit to the States.

MR. T. F. MANVILLE, president of the H. W. Johns-Manville Company, 100 William street, New York city, has returned recently from an extensive business trip throughout the West. Mr. Manville has been making investigations of business conditions, particularly in the building trades. He has found the outlook satisfactory, and believes the sentiment almost unanimous that business will begin to resume normal proportions immediately. In New York building operations are more active than ever before, and in Chicago more new building has been started since May 1 than at any one time in the history of the city. In Milwaukee the outlook for business is particularly bright. In Pittsburg and in Cleveland business is also in good shape.

MR. AND MRS. CHARLES J. GLIDDEN, who arrived on the steamer Deutschland on June 30, after an absence of over a year, will leave Boston on July 25 with the local contingent of the St. Louis tourists. This will be in continuation of their tour around the world. Mr. Glidden's Napier car, with which he made the trip to the Arctic circle last summer, and with which he will make his trip around the world, was shipped from London on Saturday last, and should arrive in Boston several days before the start for St. Louis is made. It is estimated that the suitable months of six years will be required for the trip around the world. The total journey will be about 40,000 miles, and Mr. and Mrs. Glidden have already covered about 16,200 miles of that distance.

ELECTRICAL SECURITIES.

During the short business week the market developments did not become very significant. A note of prosperity has been sounded, however, and the echo is being heard throughout the country. Aside from the events connected with the National Democratic Convention at St. Louis, crop reports continued to be the factor of importance. It is evident that the forces which are at work in the stock market are superior to even present political considerations, and the continued lapse of liquidation with favorable railroad earnings and the beneficial results of conservative financing coming to light the feeling is becoming stronger that better days are in store for us. In fact, there are those who do not hesitate to predict that the signs read that next year will be a most prosperous season. It is pointed out that a market which has shown so much resiliency under the twists which it has experienced is an indication of extraordinary inherent stability. While the state of trade is a good ways from the conditions approached in boom times, it is comparable with other years which were held to be notably easy. With this feeling extant hesitation is being overcome, and where there has been downright pessimism a better disposition is apparent and will no doubt soon work for more active speculation and investing.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JULY 2.

New York:	*Closing.*
Brooklyn Rapid Transit	50⅝
Consolidated Gas	195½
General Electric	158¾
Kings County Electric	190
Manhattan Elevated	151
Metropolitan Street Railway	116
New York & New Jersey Telephone	144
Westinghouse Manufacturing Company	175

It is reported that negotiations have been completed for the purchase by the Consolidated Gas Company of the Westchester Lighting Company, capitalized at $12,500,000. The latter company was organized by the United Gas Improvement Company, and controls the lighting business in Mount Vernon, Larchmont, Yonkers, New Rochelle, Pelham and White Plains. It owns valuable franchises, and its business has steadily increased with the development of Westchester County.

Boston:	*Closing.*
American Telephone and Telegraph	128¾
Edison Electric Illuminating	245
Massachusetts Electric	73
New England Telephone	120
Western Telephone and Telegraph preferred	81
Philadelphia:	*Closing.*
Electric Company of America	9⅛
Electric Storage Battery common	58
Electric Storage Battery preferred	58
Philadelphia Electric	6
Union Traction	53¼
United Gas Improvement	84¼
Chicago:	*Closing.*
Chicago Telephone	120
Chicago Edison Light	142
Metropolitan Elevated preferred	52
National Carbon common	28½
National Carbon preferred	102
Union Traction common	4½
Union Traction preferred	21½

Chicago Telephone gained 1,828 instruments during June. The total now in service is 110,712.

Lake Street Elevated Railway average for June was 43,856 passengers, a decrease of 1,019.

INDUSTRIAL ITEMS.

THE BALTIMORE GAS MACHINERY COMPANY, 14 West Lexington street, Baltimore, Md., is distributing an interesting booklet describing suction gas producers of its manufacture.

THE STANDARD VARNISH WORKS, New Yor city, N. Y., is sending out a folder treating on its "Voltalac" and "Gutta Percha" varnishes. Folder will be sent on request.

THE STANLEY ELECTRIC MANUFACTURING COMPANY, Pittsfield, Mass., is distributing a map, showing the location of the S. K. C. systems of long-distance electric transmission in California.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., in bulletin 84, presents an attractive series of views in connection with the installation of chloride accumulators in residential power and lighting plants.

THE DOSSERT ELECTRICAL APPLIANCE COMPANY, New York city, has been incorporated with a capital of $5,000. The directors are W. S. Blake, Sound Beach, Ct.; James C. Minehan, Albany, N. Y., and J. E. Calder, New York city.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., is issuing the July, 1904, number of *Graphite*. This number, as is usual with this publication, contains much interesting information in connection with graphite and its application.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, has issued the usual calendar of great men of science and engineering for July, 1904. This gives a portrait and biographical sketch of Professor Alexander Graham Bell.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is sending out circulars quoting prices on porcelain tubes and insulators. The company states that it is prepared to make prompt shipment and will present a most attractive proposition on correspondence.

THE CONNECTICUT TELEPHONE AND ELECTRIC COMPANY, Meriden, Ct., is making a special offer concerning its solid-back transmitter. The company will be pleased to furnish full information regarding this offer and the guaranteed quality of the instrument.

THE KINSMAN ELECTRIC AND RAILWAY SUPPLY COMPANY, 91 Liberty street, New York city, is delivering to its patrons a convenient form of calendar telephone pad card. These cards are supplied by the construction and repair department of the company.

THE POPE MANUFACTURING COMPANY, Hartford, Ct., is distributing a number of valuable booklets concerning its automobiles and motor-bicycles. These are well illustrated, and contain matter of every-day importance to owners or prospective purchasers of motor-driven vehicles.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., is enjoying a period of great activity. Its sales are greater than last year for the same time, and its established reputation for quality of apparatus and handling of trade is constantly attracting new business.

THE NATIONAL WIRE COMPANY is to remove its executive offices from New Haven, Ct., to New York city. The general offices will be at 114 Liberty street. Mr. E. B. Webster, of Boston, is president of the company, and Mr. H. Sanborn Smith, of New Haven, is vice-president and general manager.

THE BELCHER & LOOMIS HARDWARE COMPANY, Providence, R. I., has placed on the market a new specialty designated as the "Boss" weatherproof entrance bushing. This device provides a neat fitting which allows the wires to be quickly and securely fitted and avoids fishing where the wires enter the pipe.

THE STERLING ELECTRICAL MANUFACTURING COMPANY, Warren, Ohio, is distributing considerable lamp data of interest to prospective purchasers of incandescent lamps. A Fourth of July folder, entitled "A Cracker-Jack Good Thing," calls attention to several of the characteristics of the "Sterling Special" lamp.

THE B. F. STURTEVANT COMPANY, Hyde Park, Mass., is announcing the removal of its entire factory from Jamaica Plains to its new and spacious buildings at Hyde Park. It will continue to manufacture its product of blowers, engines, motors, economizers, forges, steam heating, ventilating and drying apparatus, etc.

THE INDIA RUBBER AND GUTTA PERCHA INSULATING COMPANY, Yonkers, N. Y., at a meeting of the board of trustees July 1, 1904, declared a dividend of two and one-half per cent on the capital stock, payable July 11. This company is enjoying a continued prosperity under the able management of Dr. W. M. Habirshaw, president and general manager.

THE H. W. JOHNS-MANVILLE COMPANY, New York city, has issued a complete catalogue covering "Mica" plate, cloth, segments, rings and mica in all its various forms required by the electrical industry; also "Vulcabeston," "Transite," Electrobestos" and "Niagrite." The company will be pleased to send this bulletin on request. The office is at 100 William street, New York city.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., is again in the field with a batch of engineering literature. Price lists 5127 and 5129 deal, respectively, with lightning arresters and fan motors; flyer 2126, pinched clip spring switches; flyer 2133, alternating-current buzzer; bulletin 4377, the Sprague-General Electric type M control system; bulletin 4379, Thomson high torque induction meter. A handsome booklet, entitled "Some Facts Regarding Type H Transformers," is worthy of a special enquiry.

THE DE BEERS MINES COMPANY (LIMITED), Kimberly, South Africa, has cabled an order for a third Westinghouse-Parsons steam turbine generating outfit of 1,500 kilowatts capacity for its power plant at Kimberly. The new turbine unit will be similar in every respect to the two which have been in operation for somewhat over a year. That a concern with the standing of the De Beers company should install machinery built at such a distance speaks well for the confidence which it places in it. The new turbine unit will operate at 150 pounds boiler pressure, thirty-five degrees superheat and about twenty-three-inch vacuum. Taking into account the altitude of Kimberly, this would be equivalent to about twenty-seven-inch vacuum at sea level. The new unit will be shipped *via* New York in about six months.

THE DIAMOND STONE BRICK COMPANY is rushing to completion its plant at Wilmington, Del., for the manufacture of sand-lime brick, and expects to begin operations within the next two or three weeks. These brick are manufactured from the highest grade of silica sand and pure calcium lime. They will stand a crushing strain greater than clay brick and a greater degree of temperature, and the manufacturer guarantees a water absorption of less than twelve per cent. These brick improve with age in the atmosphere or under water, and will not crack or disintegrate by freezing. They can be furnished in any color or shade desired. The natural color, however, is a beautiful soft gray, resembling Indiana limestone or sandstone. The Charles Warner Company, of Philadelphia, Pa., and Wilmington, Del., will supply the raw materials for manufacturing the brick and will have the general sales agency. Delivery can be made by water to New York, Philadelphia, Trenton and Camden, N. J., Baltimore, Washington, Norfolk and Portsmouth, and *via* rail to intermediate points.

THE MISSOURI PACIFIC RAILWAY AND IRON MOUNTAIN ROUTE (the Great Southwest System) are carrying a large traffic to the St. Louis World's Fair. In anticipation of this extensive arrangements were made in schedules and equipments prior to the opening of the fair. These companies have issued a handsome souvenir world's fair bulletin, giving full information concerning their service and exhibiting a map and index of the exposition grounds. There is also a fine map of the Missouri Pacific Railway and the St. Louis, Iron Mountain & Southern Railway. Special accommodations are made for enquirers who contemplate trips from St. Louis to such points as Hot Springs, Ark., or to other health resorts in Colorado or Mexico, or to any point in the West or Southwest, at the St. Louis ticket office, southeast corner of Sixth and Olive streets. Among other delightful booklets issued by this system are those descriptive of Colorado Springs, Manitou, Denver and Cripple Creek; several on the hot springs of Arkansas; San Antonio as a health and pleasure resort; the Glenwood hot springs, Colorado, a health and pleasure resort.